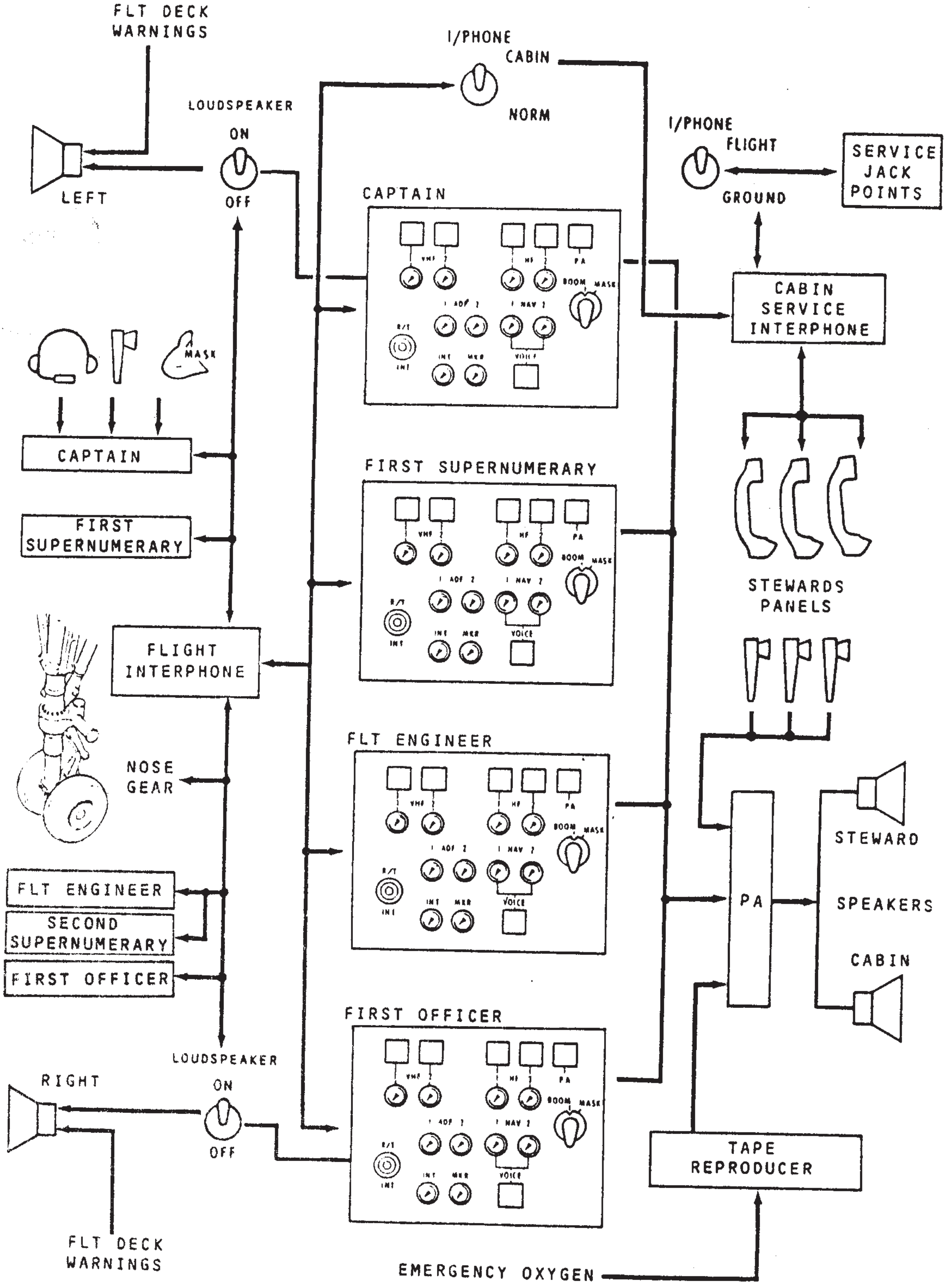
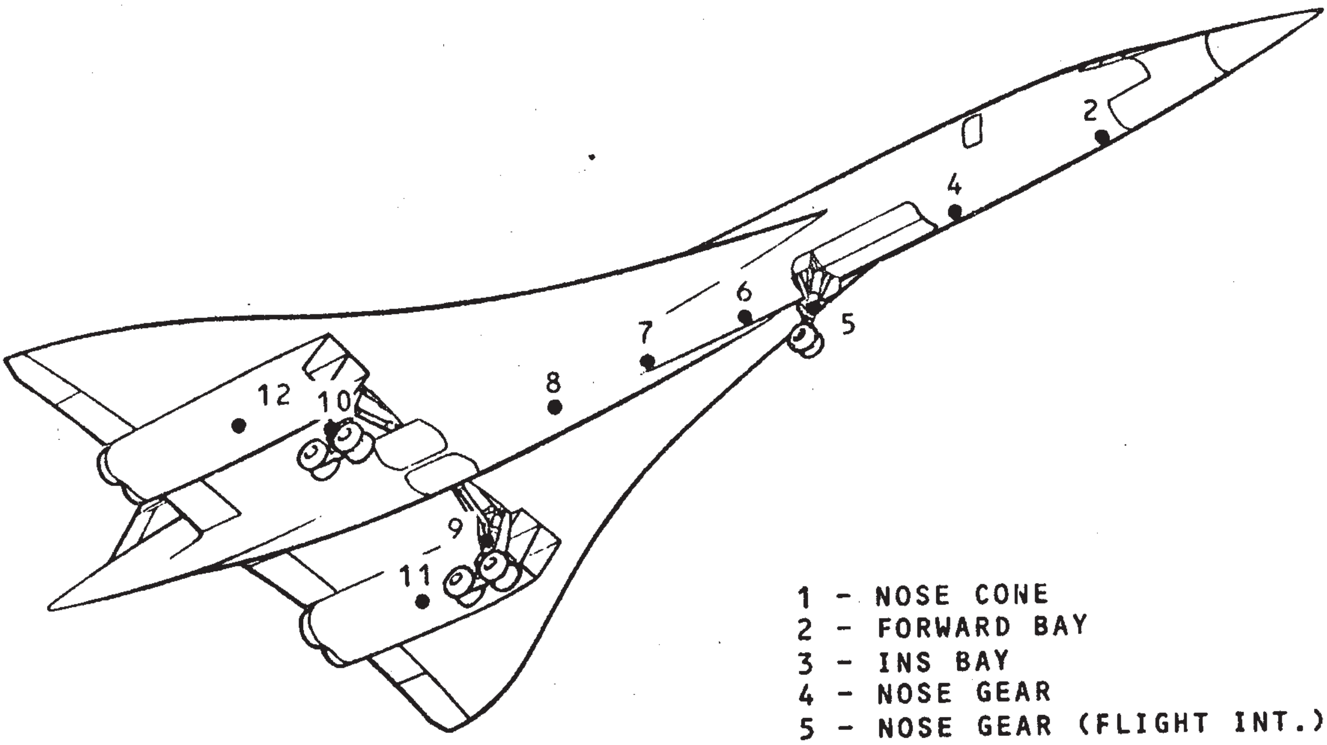
INTERPHONE AND PA SYSTEM

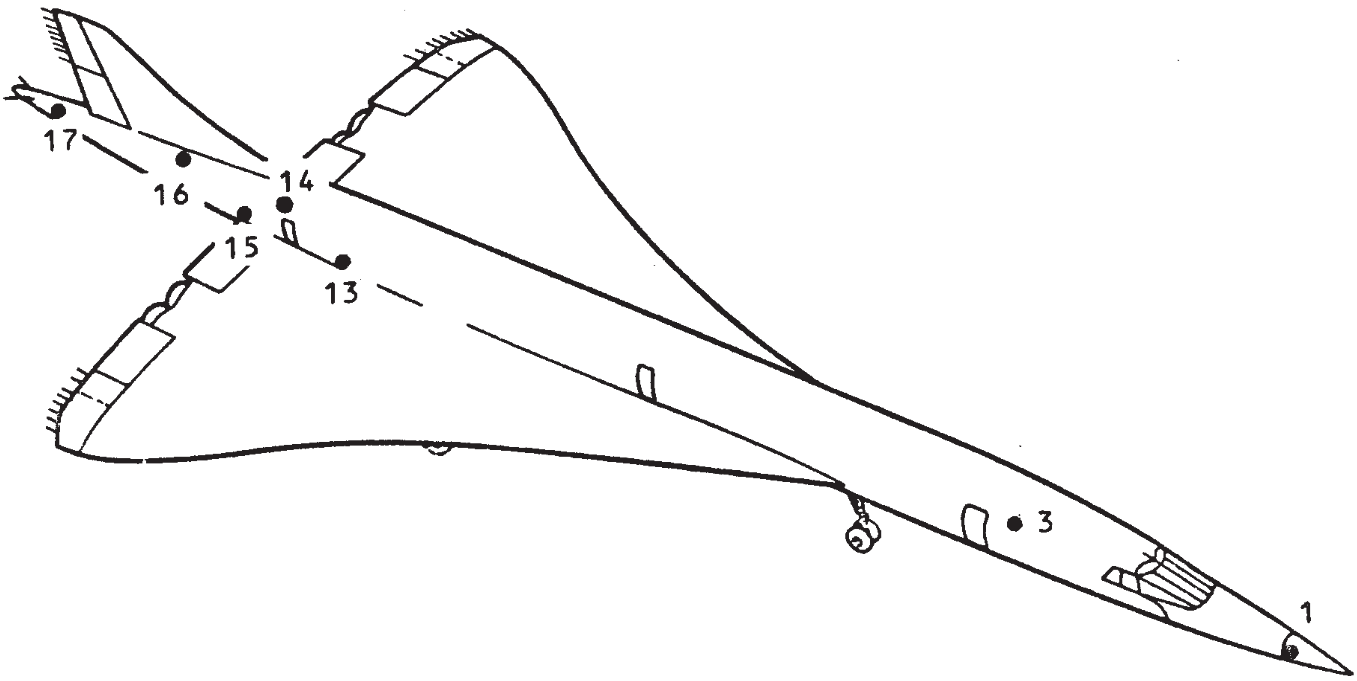


GROUND SERVICE JACK POINTS

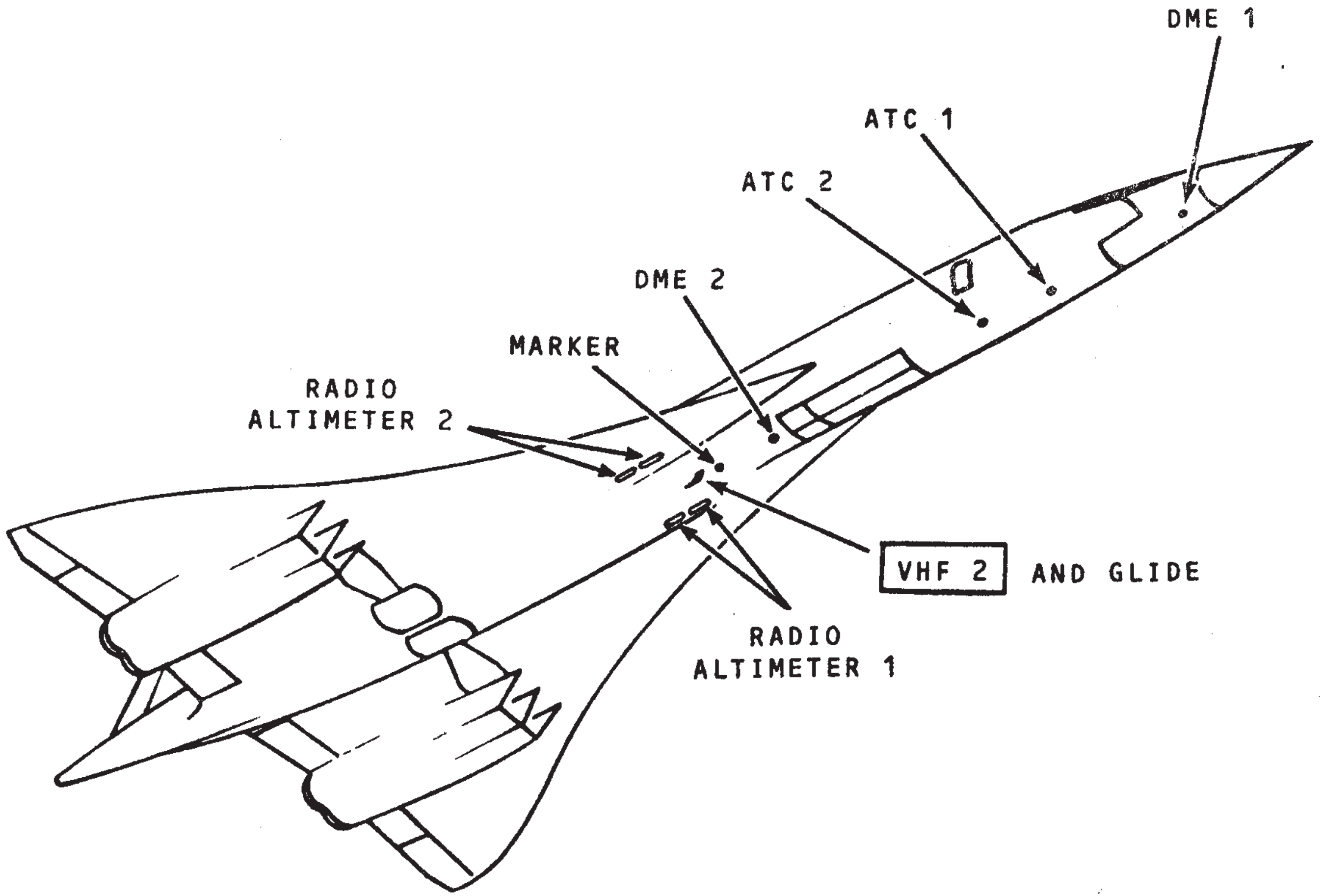


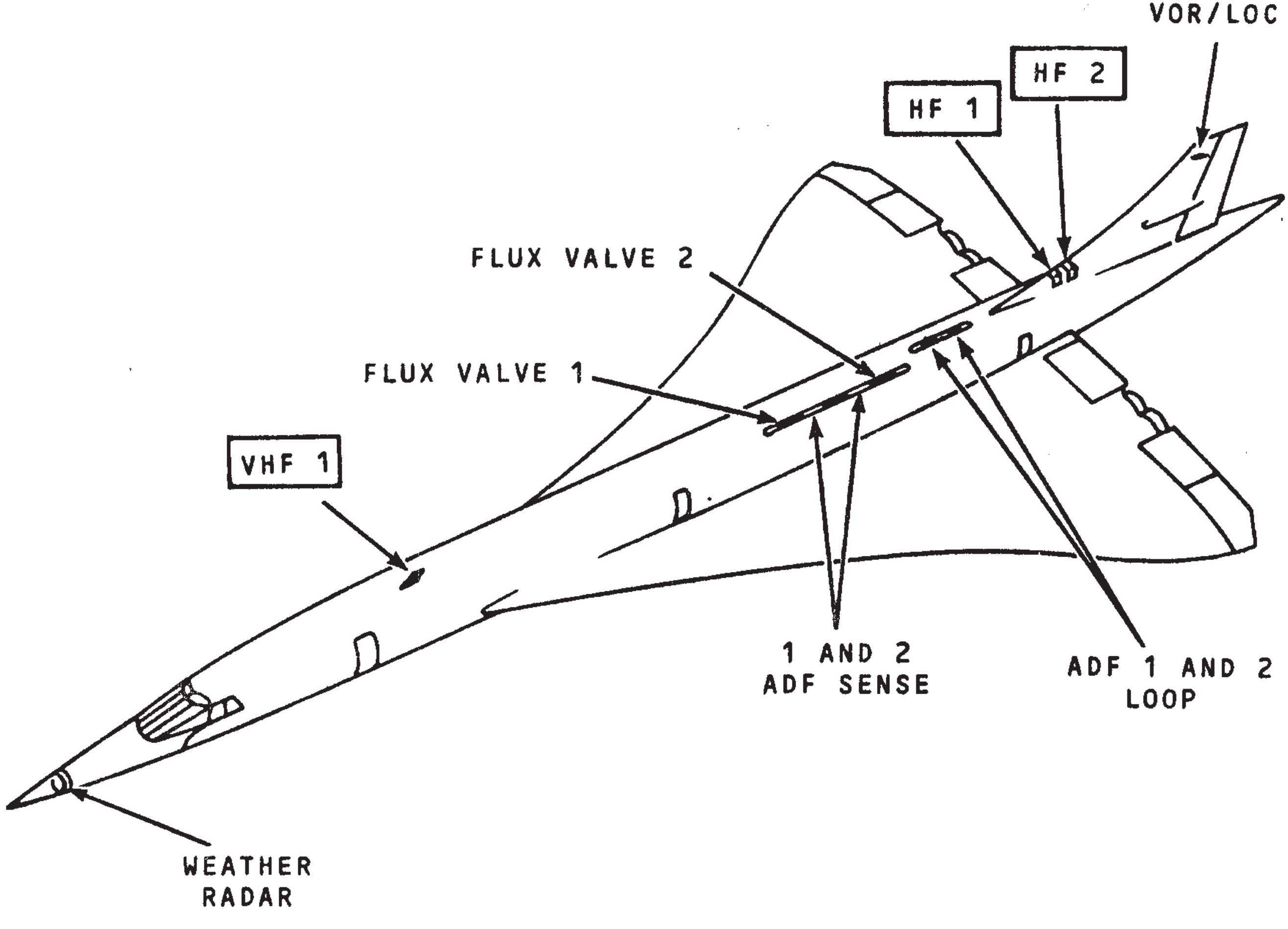
1 - NOSE CONE
2 - FORWARD BAY
3 - INS BAY
4 - NOSE GEAR
5 - NOSE GEAR (FLIGHT INT.)
6 - BAY
7 - BAY
8 - FUEL REFUELLING PANEL
9 - LEFT LANDING GEAR
10 - RIGHT LANDING GEAR
11 - LEFT ENGINE NACELLE
12 - RIGHT ENGINE NACELLE
13 - AIR BAY
14 - HYDRAULIC BAY
15 - REAR ELECTRONIC BAY
16 - REAR DOOR
17 - TAIL CONE

≡ STATIC DISCHARGERS

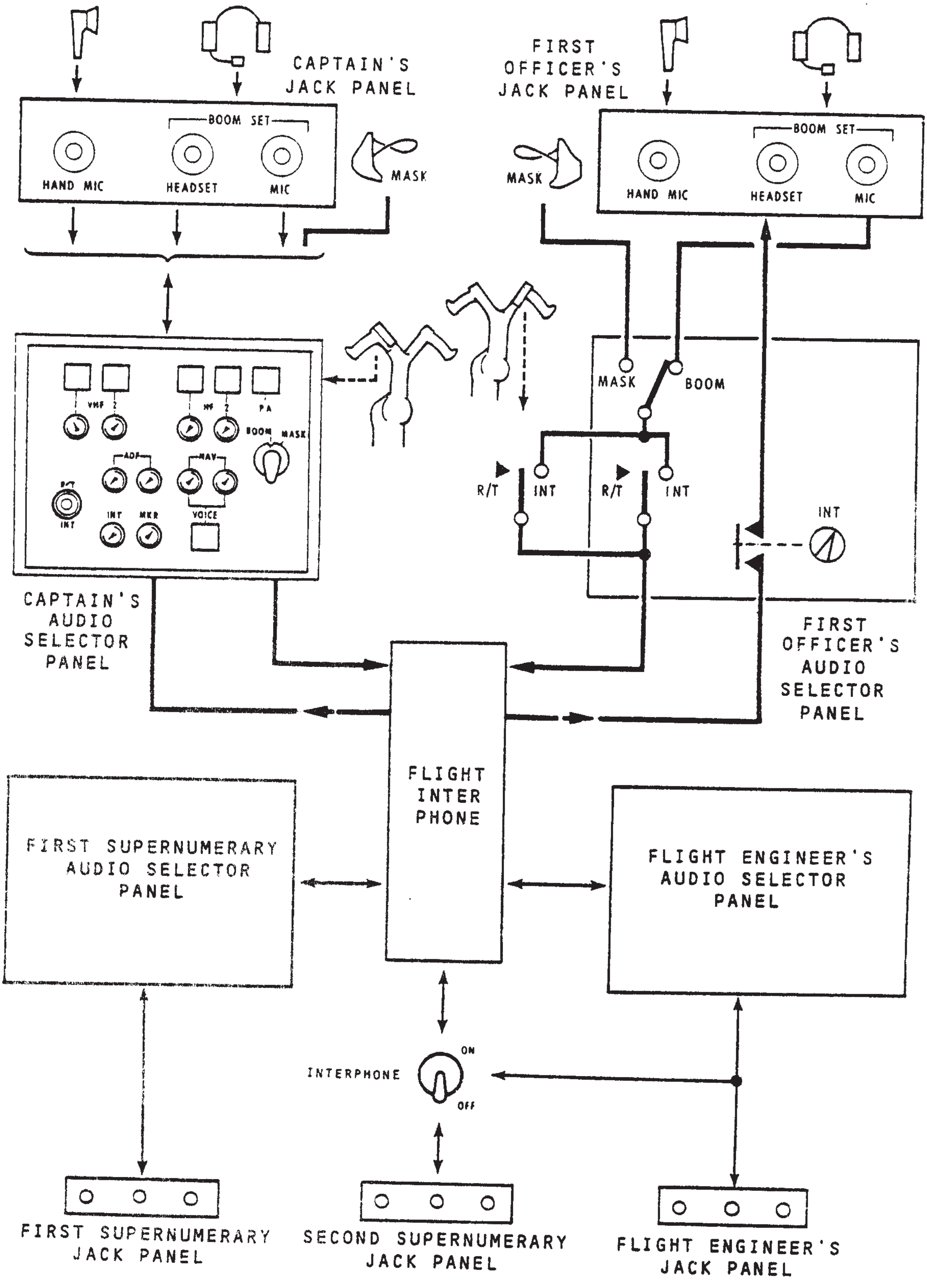


ANTENNAE LOCATION

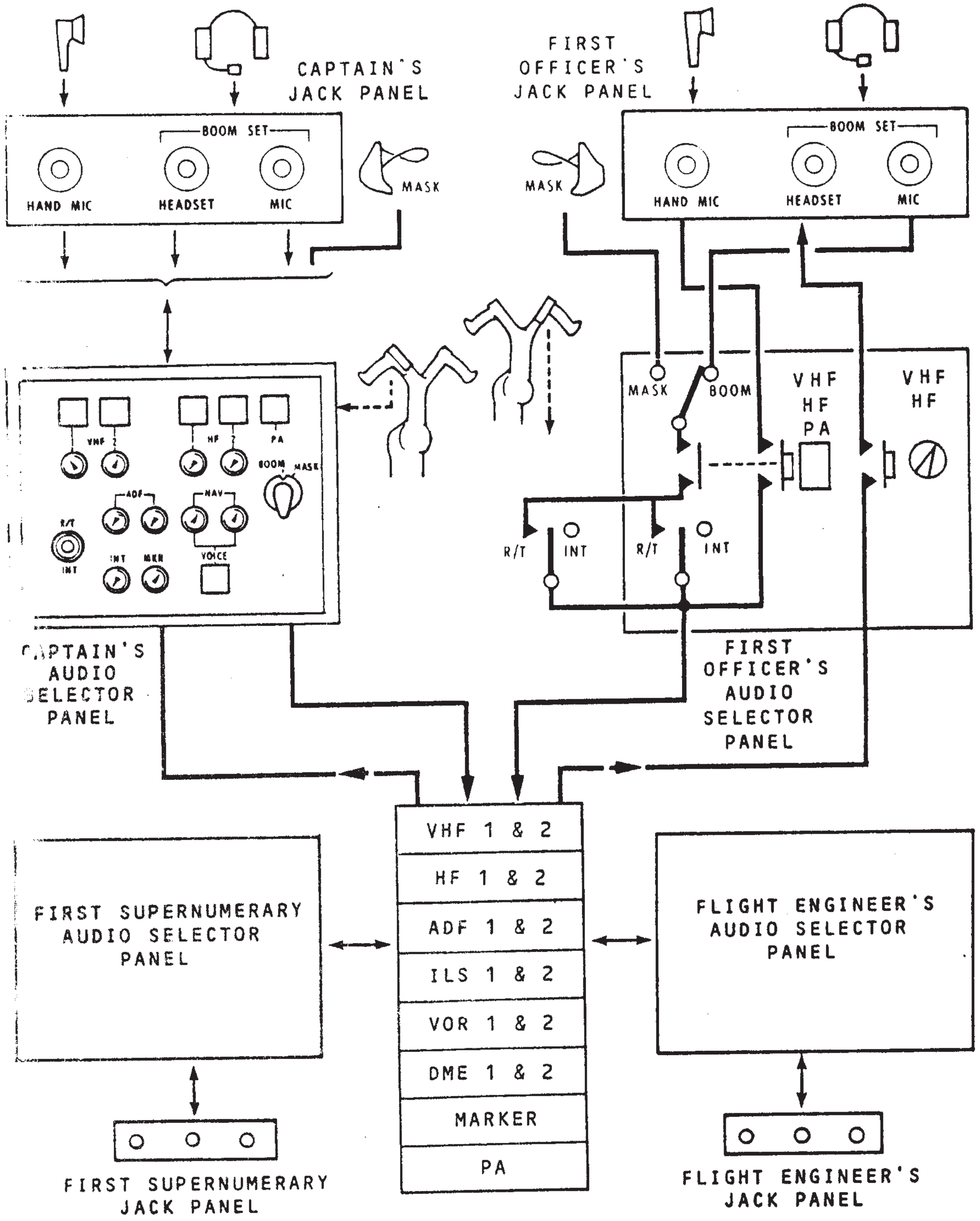




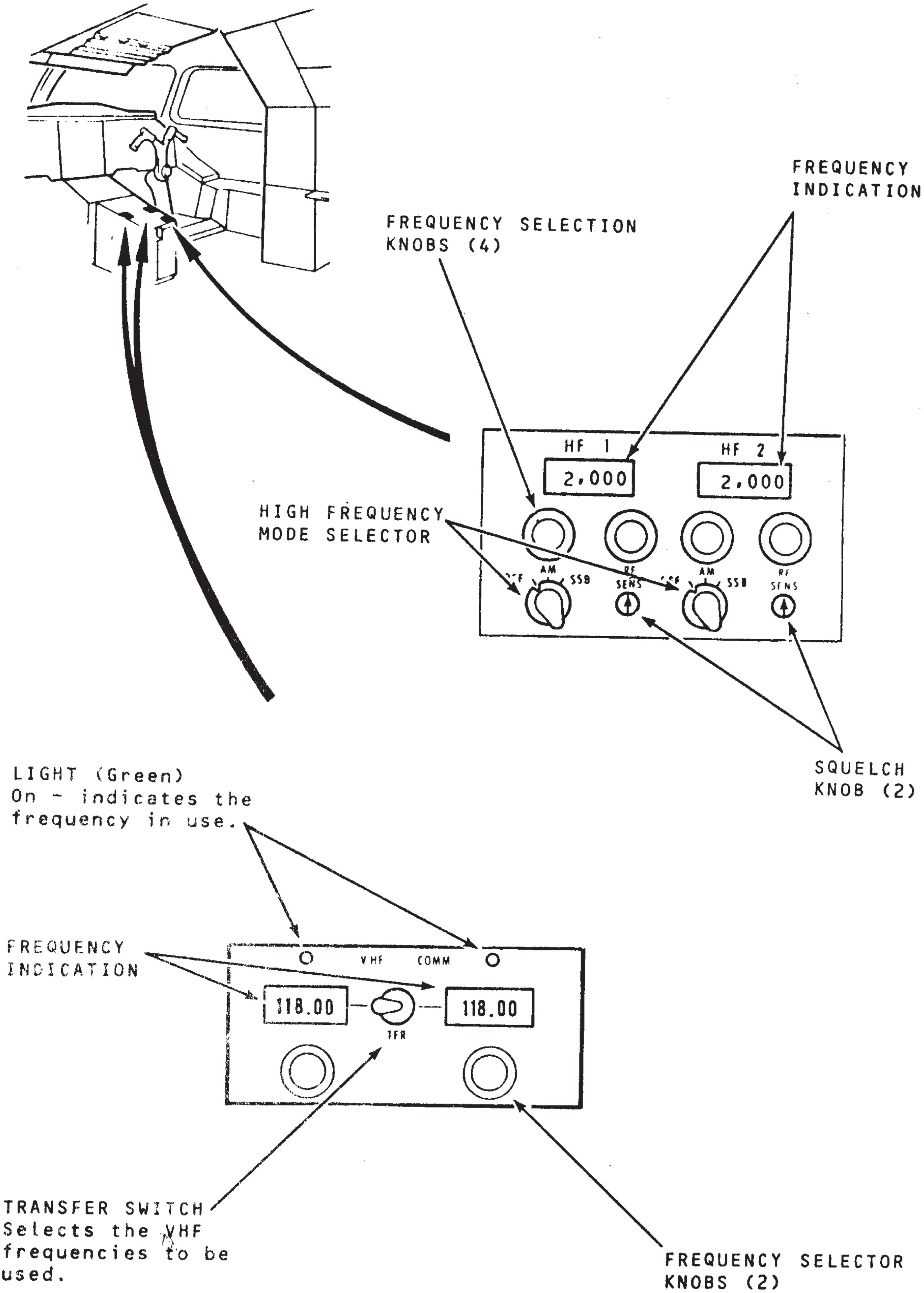
AUDIO SELECTOR PANEL FLIGHT INTERPHONE


CAPTAIN'S JACK PANEL
BOOM SET
HAND MIC
HEADSET
MIC
MASK
FIRST OFFICER'S JACK PANEL
MASK
BOOM SET
HAND MIC
HEADSET
MIC
VHF 1 2
HF 1 2
PA
BOOM MASK
ADF
NAV
R/T
INT
INT
MKR
VOICE
CAPTAIN'S AUDIO SELECTOR PANEL
MASK
BOOM
R/T
INT
R/T
INT
INT
FIRST OFFICER'S AUDIO SELECTOR PANEL
FLIGHT INTER PHONE
FIRST SUPERNUMERARY AUDIO SELECTOR PANEL
FLIGHT ENGINEER'S AUDIO SELECTOR PANEL
INTERPHONE
ON
OFF
FIRST SUPERNUMERARY JACK PANEL
SECOND SUPERNUMERARY JACK PANEL
FLIGHT ENGINEER'S JACK PANEL

AUDIO SELECTOR PANEL RADIO

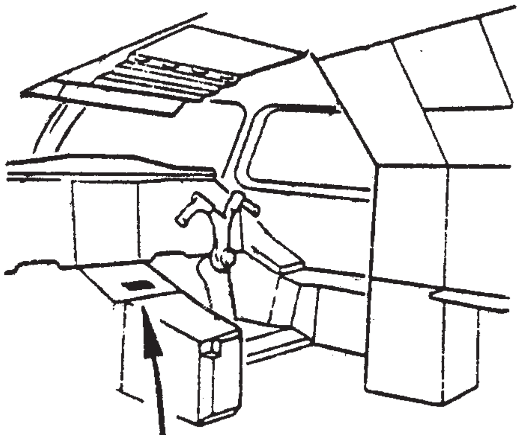

CAPTAIN'S JACK PANEL
BOOM SET
HAND MIC
HEADSET
MIC
MASK
FIRST OFFICER'S JACK PANEL
BOOM SET
HAND MIC
HEADSET
MIC
MASK
VHF 2
HF 2
PA
BOOM
MASK
ADF
NAV
R/T
INT
INT
MKR
VOICE
CAPTAIN'S AUDIO SELECTOR PANEL
MASK
BOOM
VHF HF PA
VHF HF
R/T
INT
R/T
INT
FIRST OFFICER'S AUDIO SELECTOR PANEL
VHF 1 & 2
HF 1 & 2
ADF 1 & 2
ILS 1 & 2
VOR 1 & 2
DME 1 & 2
MARKER
PA
FIRST SUPERNUMERARY AUDIO SELECTOR PANEL
FLIGHT ENGINEER'S AUDIO SELECTOR PANEL
FIRST SUPERNUMERARY JACK PANEL
FLIGHT ENGINEER'S JACK PANEL

VHF AND HF SELECTION


FREQUENCY INDICATION
FREQUENCY SELECTION KNOBS (4)
HF 1
2.000
HF 2
2.000
HIGH FREQUENCY MODE SELECTOR
AM
SSB
RF SENS
SQUELCH KNOB (2)
LIGHT (Green) On - indicates the frequency in use.
FREQUENCY INDICATION
VHF COMM
118.00
TFR
118.00
TRANSFER SWITCH Selects the VHF frequencies to be used.
FREQUENCY SELECTOR KNOBS (2)

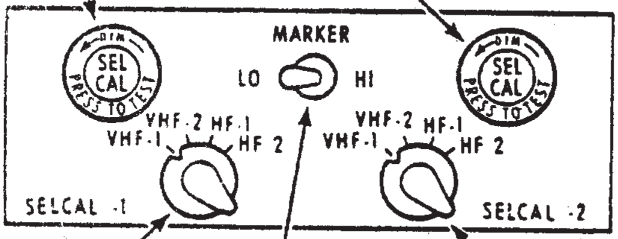
(Unchanged)

SELCAL PANEL



**SELECTIVE CALLING 1 and 2
PUSH BUTTON LIGHTS (Amber)**

On (flashing) - indicates the aircraft is being called on the selected channel. Accompanied by an audio (two tone chime) repeated every five seconds.
Pressed - tests the associated decoder. Accompanied by SELCAL lights 1 and 2 flashing and audio warning (two tone chime) repeated every five seconds.



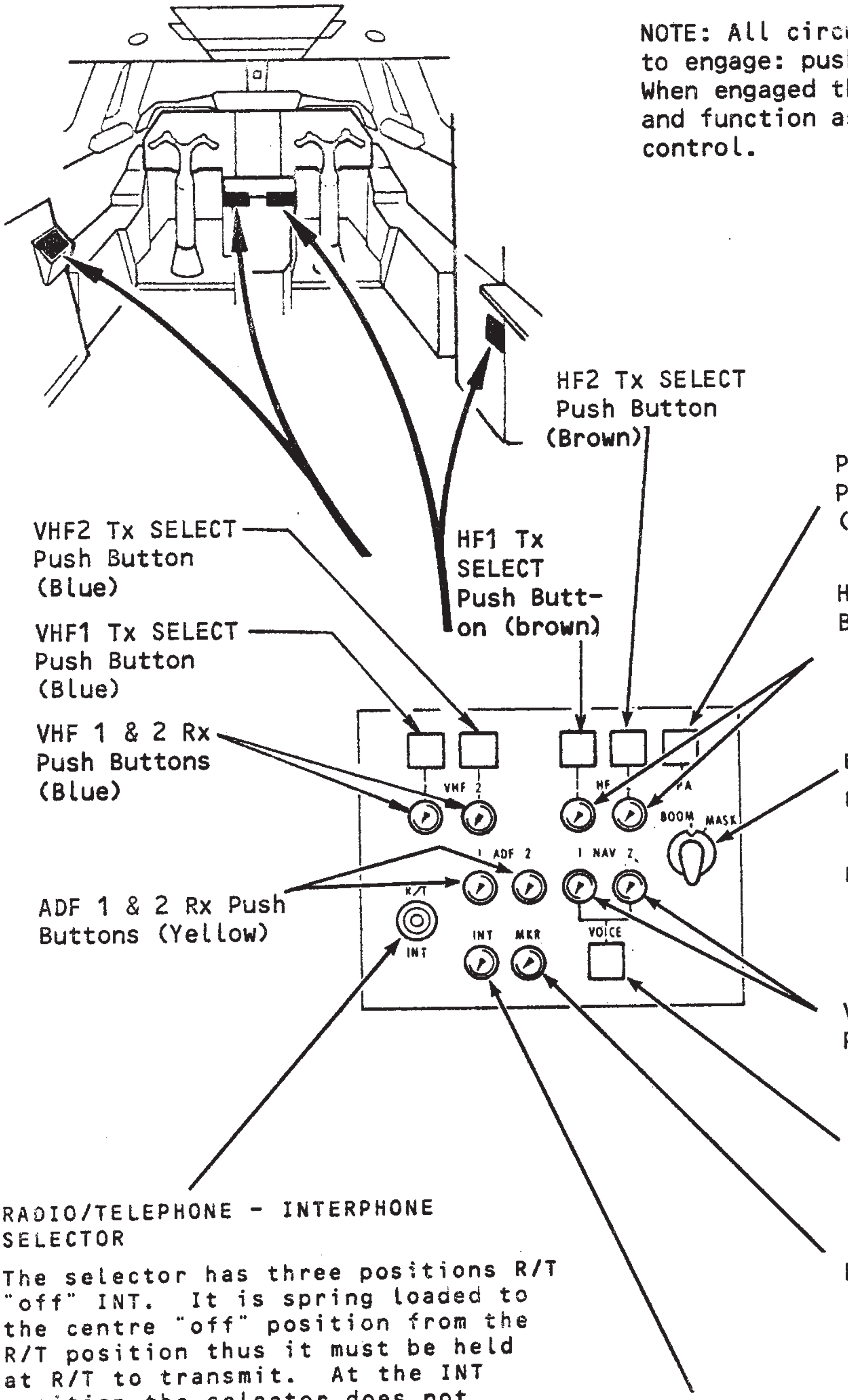
SELECTIVE CALLING 1
MODE SELECTOR

SELECTIVE CALLING 2
MODE SELECTOR

MARKER RECEIVER
SENSITIVITY SWITCH

AUDIO PANELS

NOTE: All circular pbs are push to engage: push to disengage. When engaged the pbs illuminate and function as a rotary volume control.



HF2 Tx SELECT
Push Button
(Brown)

PA SELECT
Push Button
(Grey)

VHF2 Tx SELECT
Push Button
(Blue)

HF1 Tx
SELECT
Push Button (brown)

HF 1 & 2 Rx Push
Buttons (Brown)

VHF1 Tx SELECT
Push Button
(Blue)

VHF 1 & 2 Rx
Push Buttons
(Blue)

BOOM/MASK SELECTOR

BOOM - selects the boomset microphone.

MASK - selects the oxygen mask microphone.

ADF 1 & 2 Rx Push
Buttons (Yellow)

VHF NAV 1 & 2 Rx
Push Buttons (Green)

VOICE/RANGE FILTER
BUTTON (Green)

MARKER Rx Push
Button (Amber)

RADIO/TELEPHONE - INTERPHONE SELECTOR

The selector has three positions R/T "off" INT. It is spring loaded to the centre "off" position from the R/T position thus it must be held at R/T to transmit. At the INT position the selector does not spring return to "off".

R/T - transmission is made through the depressed push button.

INT - transmission is made through the interphone regardless of selection channel being depressed.

INTERPHONE PUSH BUTTON LIGHT (White) AND SWITCH

The circular knob is for listening to the transmission and the reply. It is an on/off volume control switch and it illuminates when pressed.

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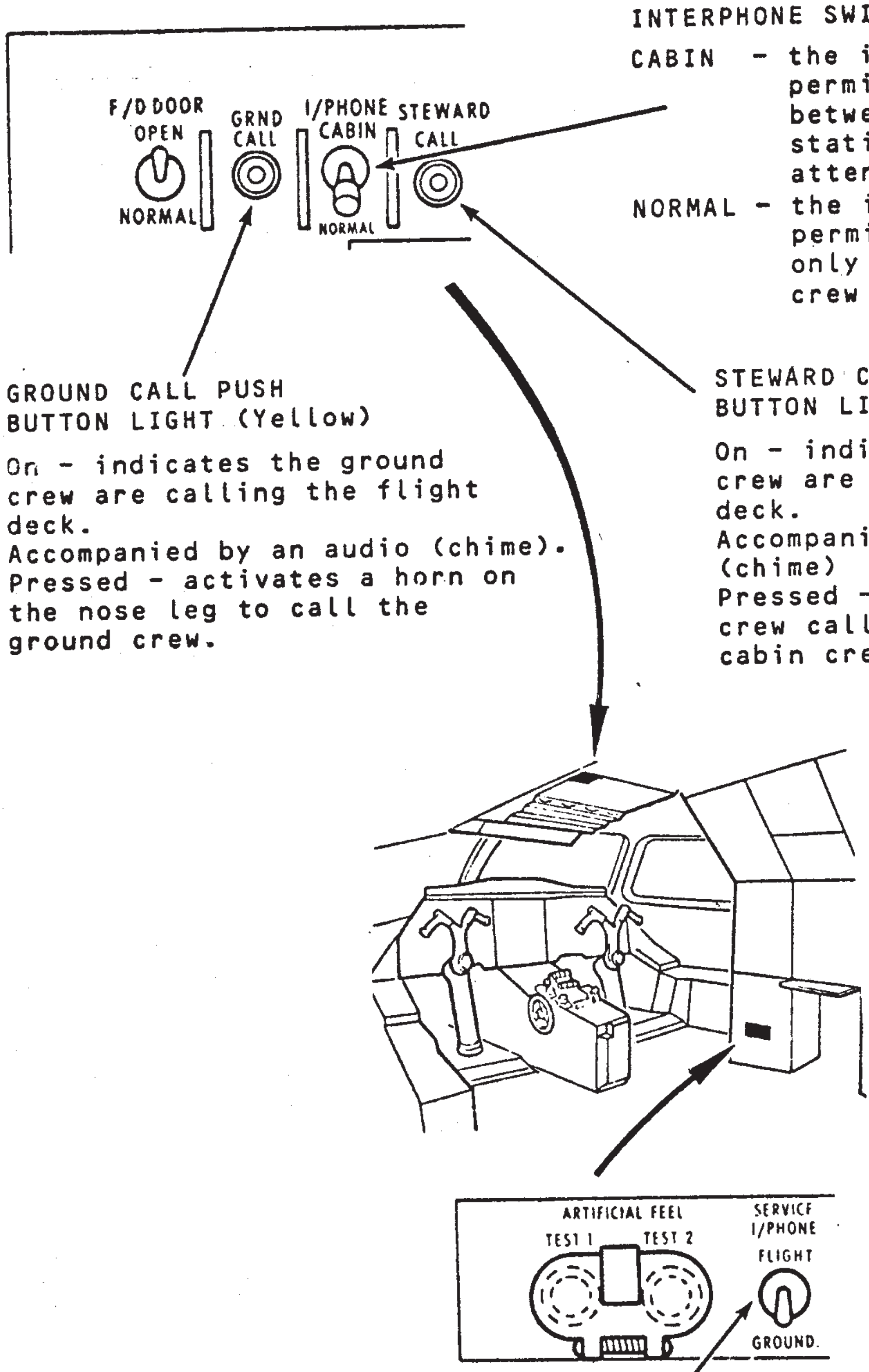
INTERPHONE SWITCHES



INTERPHONE SWITCH

CABIN - the interphone systems permit communication between the flight crew stations and the cabin attendants' stations.

NORMAL - the interphone system permits communication only between the flight crew stations.

GROUND CALL PUSH BUTTON LIGHT (Yellow)

On - indicates the ground crew are calling the flight deck.
Accompanied by an audio (chime).
Pressed - activates a horn on the nose leg to call the ground crew.

STEWARD CALL PUSH BUTTON LIGHT (Yellow)

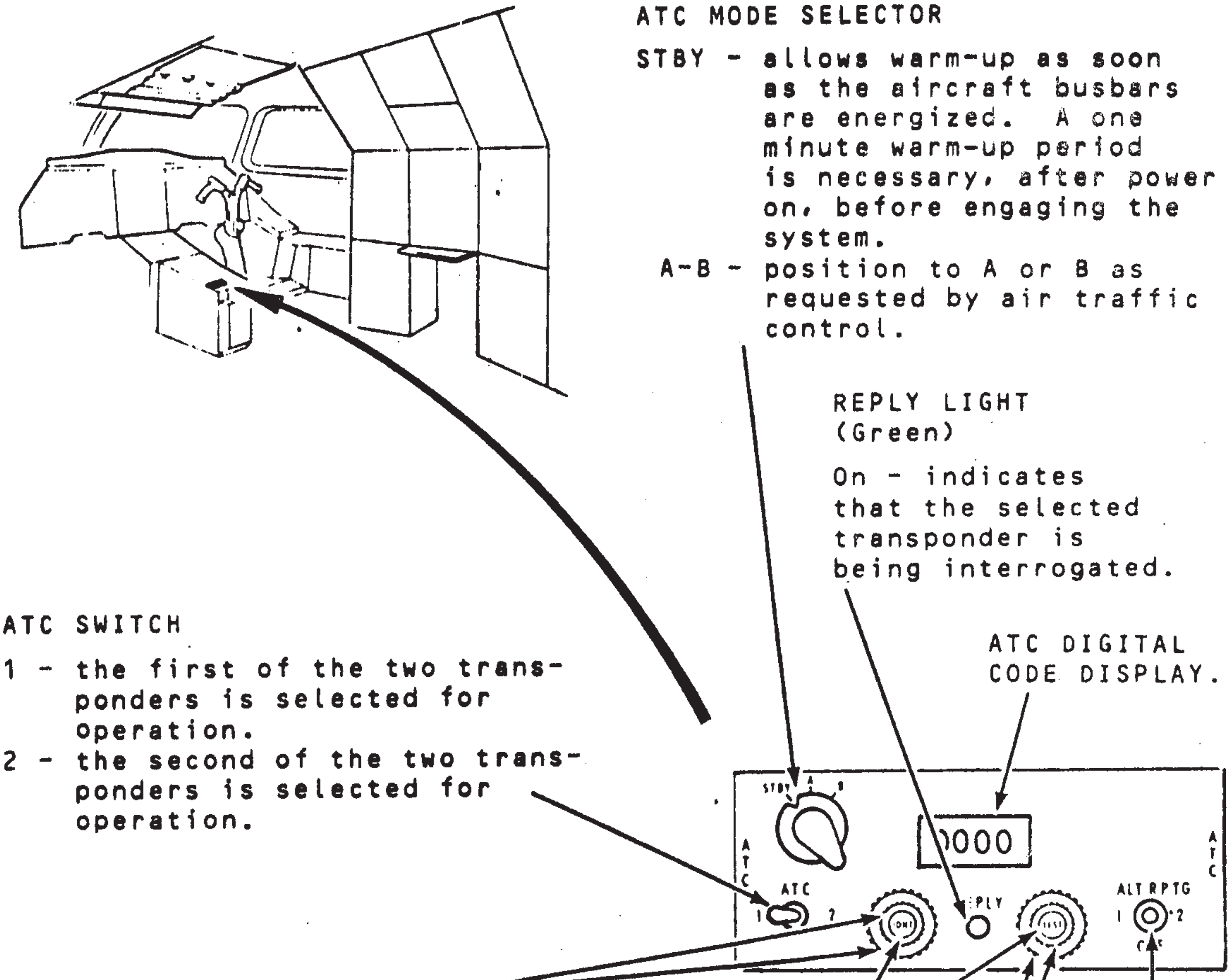
On - indicates the cabin crew are calling the flight deck.
Accompanied by an audio (chime)
Pressed - activates cabin crew call lights on the cabin crew panels.

SERVICE INTERPHONE SWITCH

FLIGHT - isolates the maintenance jack boxes from the cabin service interphone system.

GROUND - connects the maintenance jack boxes into the cabin service interphone system.

ATC TRANSPONDER



ATC MODE SELECTOR

STBY - allows warm-up as soon as the aircraft busbars are energized. A one minute warm-up period is necessary, after power on, before engaging the system.

A-B - position to A or B as requested by air traffic control.

REPLY LIGHT
(Green)

On - indicates that the selected transponder is being interrogated.

ATC SWITCH

1 - the first of the two transponders is selected for operation.

2 - the second of the two transponders is selected for operation.

ATC DIGITAL CODE DISPLAY.

CODE SELECTOR KNOBS (2)
(Left hand digits)

IDENTIFICATION PUSH BUTTON

Pressed - gives additional pulse reply for positive identification.

CODE SELECTOR KNOBS (2)
(Right hand digits)

TEST PUSH BUTTON

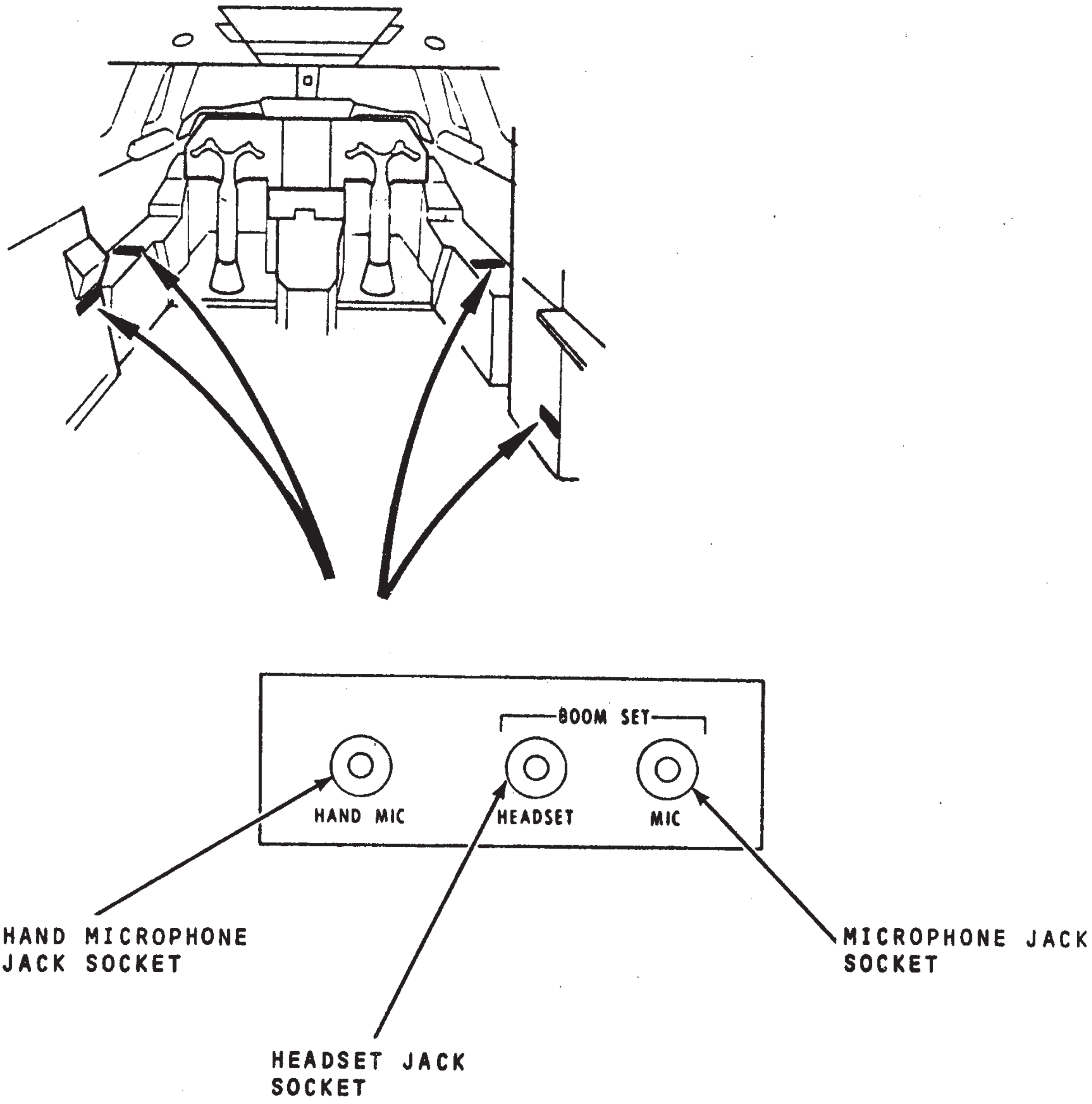
Pressed - tests the transponder function; if the test is successful the REPLY light comes on and remains on for at least 15 seconds.

ALTITUDE REPORTING SWITCH

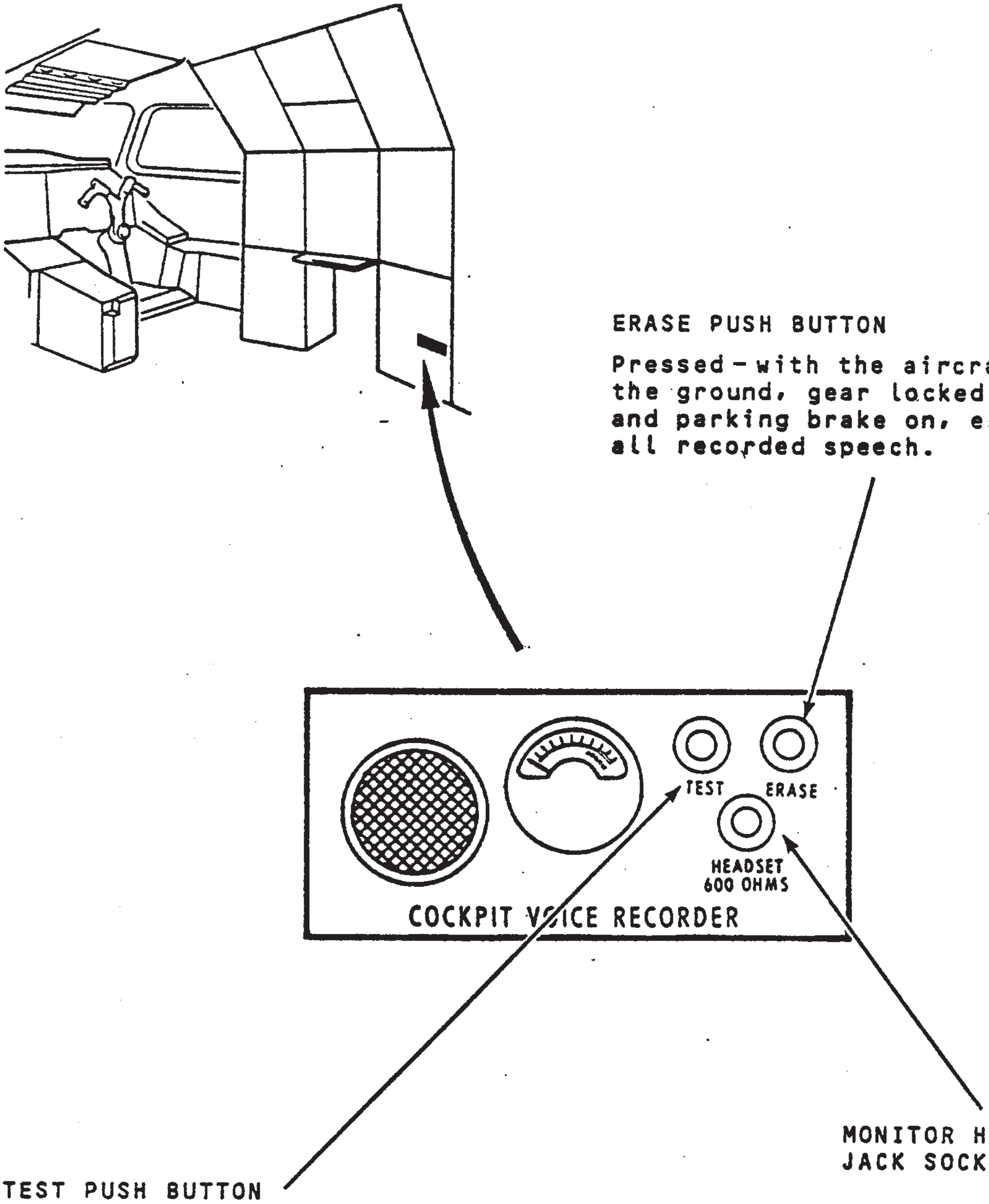
1 - the altitude reporting function that transmits altitude information to the ground radar uses the altitude from ADC1.

2 - the altitude reporting function uses the altitude from ADC 2.

BOOM/MASK SWITCH PANEL



COCKPIT VOICE RECORDER



ERASE PUSH BUTTON

Pressed – with the aircraft on the ground, gear locked down and parking brake on, erases all recorded speech.

MONITOR HEADSET JACK SOCKET

TEST PUSH BUTTON

Pressed – inserts a test signal for 0.8 secs into each recording channel in turn.
After a pause the meter shows four successive outputs and the monitor headset receives four successive 600 Hz tones.

(Unchanged)

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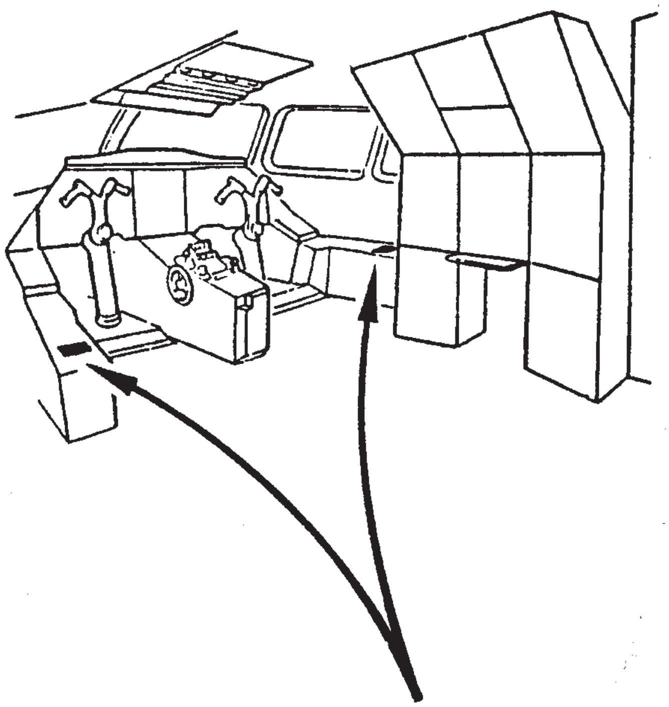
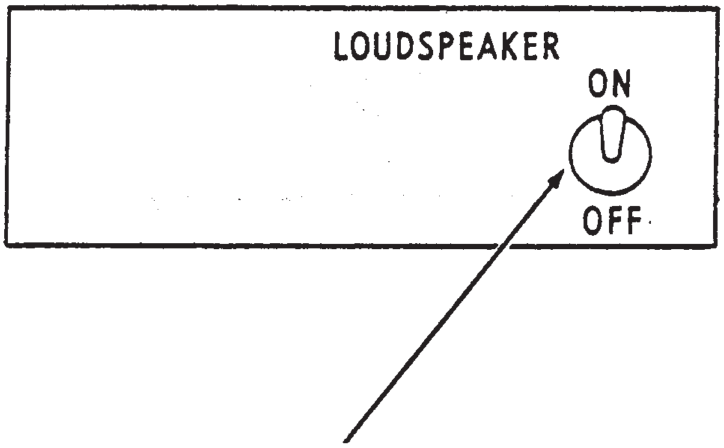
LOUDSPEAKER





LOUDSPEAKER SWITCH

ON - Communications and MWS audio warnings are relayed via the loudspeaker.

OFF - only MWS audio warnings are relayed via the loudspeaker.

Chapter 6

ELECTRICAL

ELECTRIC

CIRCUIT BREAKER LIST

The following sections are contained in a separate booklet entitled "CIRCUIT BREAKER LISTING".

06.04	CIRCUIT BREAKER LIST	- SYSTEMS
06.05	CIRCUIT BREAKER LIST	LOSS OF DC BUSBARS
06.06	CIRCUIT BREAKER LIST	LOSS OF AC BUSBARS

ELECTRICAL

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Schematics

Electrical Power Circuit Breaker Panels 06.02.01
Electrical Power Control Panel 06.02.02
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Ancillary Busbars 06.02.04
Electronic Supplies 06.02.05

Controls and Indicators

Constant Speed Drive 06.03.01
Generator 06.03.02
A.C. Power 06.03.03
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D.C. Power (Sheet 2 of 2) 06.03.05
Essential A.C. (Sheet 1 of 2) 06.03.06
Essential A.C. (Sheet 2 of 2) 06.03.07
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Circuit Breaker List - Panel Location 06.04.01

Circuit Breaker List - Systems 06.04.02

Circuit Breaker List - Loss of D.C. Busbars 06.05.01

Circuit Breaker List - Loss of A.C. Busbars 06.06.01

ELECTRICAL

General

Electrical power for the aircraft is supplied from four engine mounted integrated drive generators (IDG) with a hydraulically driven emergency generator for essential supplies under failure or emergency conditions.

Ground power can be connected to the aircraft distribution system through a single ground connection.

The electrical generating system is a.c. with d.c. power provided by transformer rectifier units (TRU) and batteries.

DESCRIPTION

AC Generating System

During ground operations power is supplied from an external source. When the ground power unit is connected to the aircraft its output is automatically checked for voltage, frequency and direction of rotation.

A ground power breaker is closed to direct the ground supply to the split system breakers, the bus tie breakers and hence the a.c. main busbars.

In flight normal power is supplied by four engine-driven IDGs. At engine start the output from each generator is automatically connected to its a.c. main busbar when minimum control conditions of voltage and frequency are reached and the frequency synchronism is acceptable to the busbar.

Frequency control of each generator is provided by its constant speed drive (CSD). CSD disconnect is available at any time but it can only be reset on the ground with the engine stopped.

The generator is at all times protected from faults and will trip if limits are exceeded.

AC Distribution System

Each generator is connected to its a.c. main busbar (1X 2X 3X and 4X) by a generator circuit breaker (GCB). The generators outputs may be used in parallel combination up to all four in parallel, the busbars being interconnected by means of bus tie breakers (BTB) and split system breakers (SSB). The SSB connect the left hand main a.c. system to the right hand main a.c. system. Each BTB connects an a.c. main busbar in parallel with the other a.c. main busbars.

Normally the a.c. essential busbars (5X 6X 7X and 8X) are powered, each from its associated a.c. main busbar, but if any a.c. main busbar fails the emergency generator automatically starts and connects to the dead a.c. essential busbar.

Emergency Generation

An emergency generator powered by a hydraulic motor supplied from the green hydraulic system is capable of supplying sufficient power for all essential electrical systems in flight. The emergency generator automatically starts if any a.c. main busbar fails or if No. 1 and No. 2 engines fail while airborne.

Emergency Distribution

Under failure conditions the emergency generator is directly connected to 16X and through the auto shed breaker (ASB) to 17X. 16X powers the a.c. essential busbars 5X, 6X and relight busbars 24X, 25X, 26X and 27X. 17X powers the a.c. essential busbars 7X, 8X supplying engine and other services which are not available under engines No. 1 and No. 2 failure conditions which open the ASB.

Standby instrument busbars 32X and 33X, normally powered from the a.c. essential busbar 5X, are automatically powered from the d.c. essential busbar 3P when RAT is selected.

D.C. Generating System

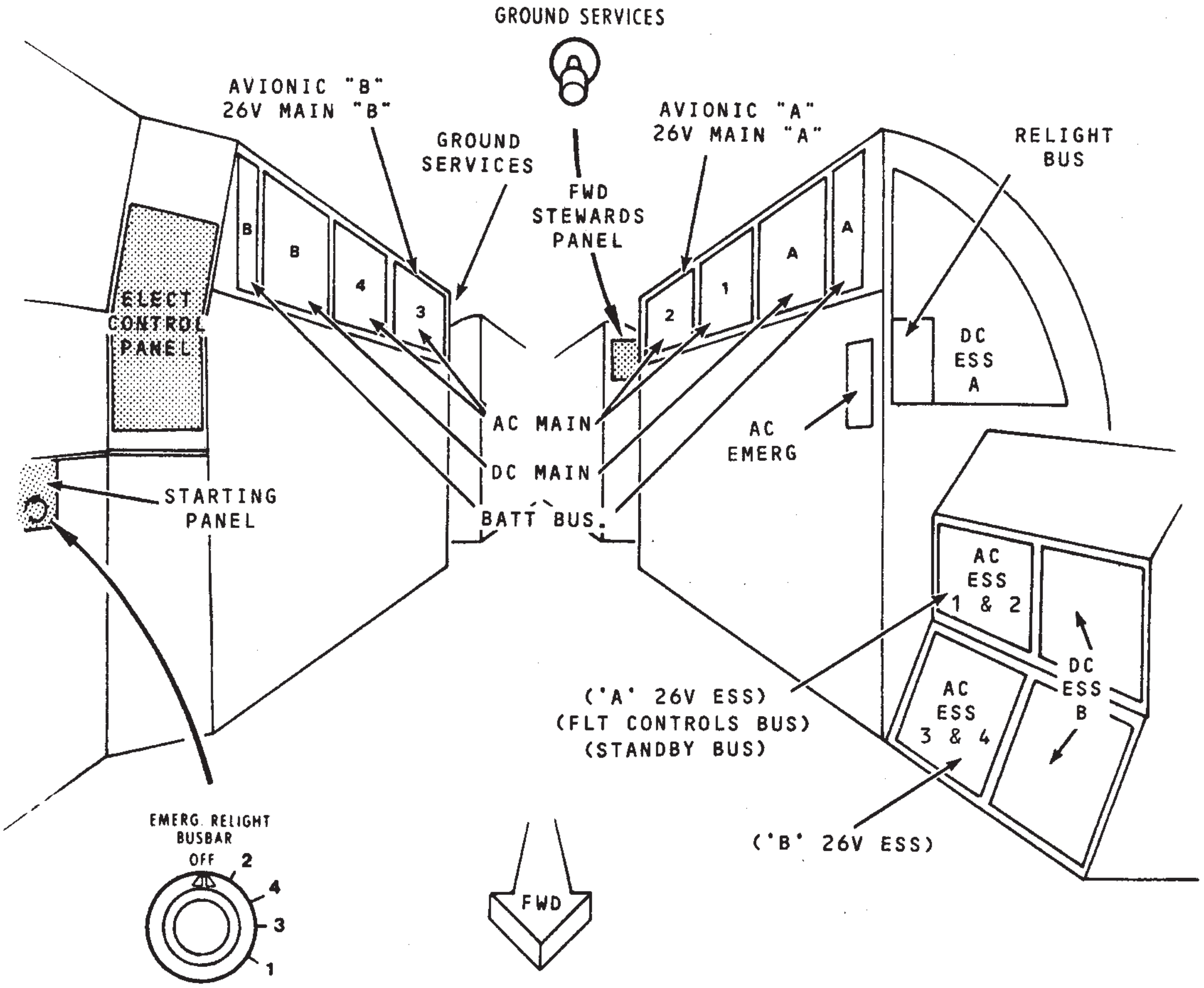
Four transformer rectifier units (TRU) are the primary source of d.c. power. TRU No. 1 and No. 4 are powered from the a.c. essential busbars 5X and 8X. TRU No. 2 and No. 3 are powered from the a.c. main busbars 2X and 3X.

D.C. Distribution System

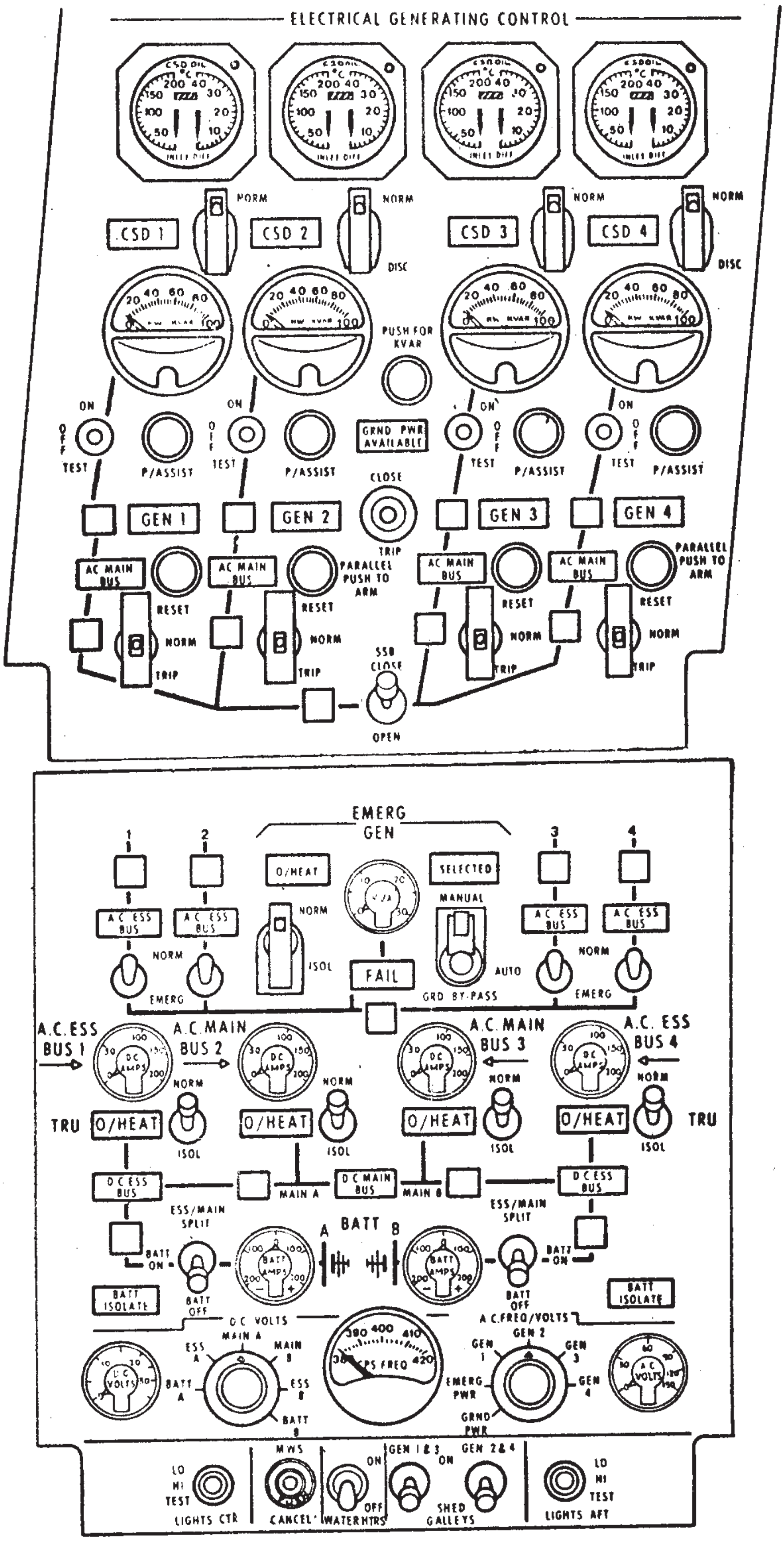
The TRU No. 2 and No. 3 power the d.c. main busbars 1P and 2P and TRU No. 1 and No. 4 power the d.c. essential busbars 3P and 4P. The d.c. main busbar is in two parts, 1P and 2P, connected by fuses.

One battery is connected to each d.c. essential busbar. The d.c. essential busbars are connected to the d.c. main busbar by fuses and essential/main isolate breakers.

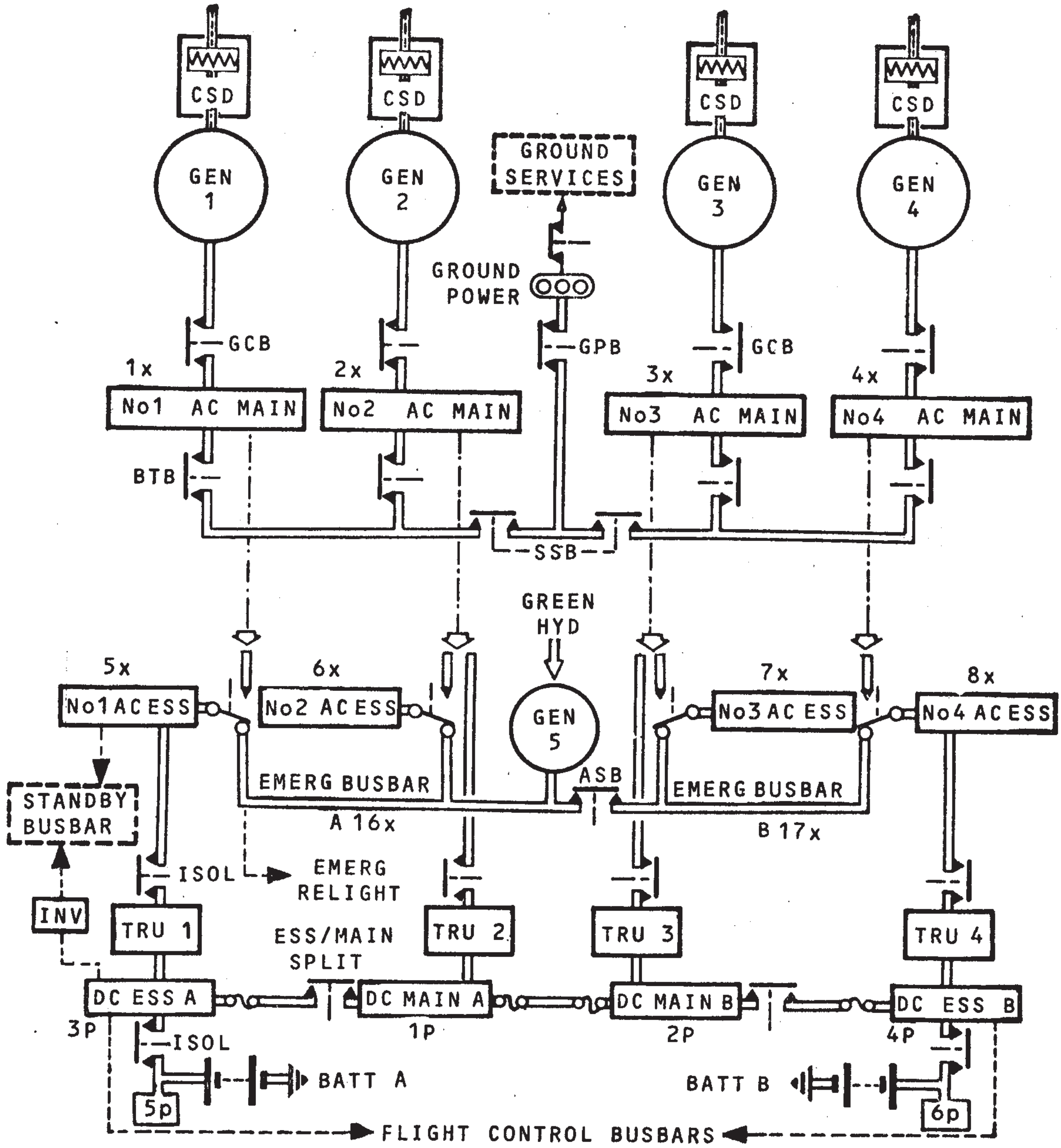
ELECTRICAL POWER CIRCUIT BREAKER PANELS



ELECTRICAL GENERATING CONTROL PANEL



ELECTRICAL SYSTEM SCHEMATIC



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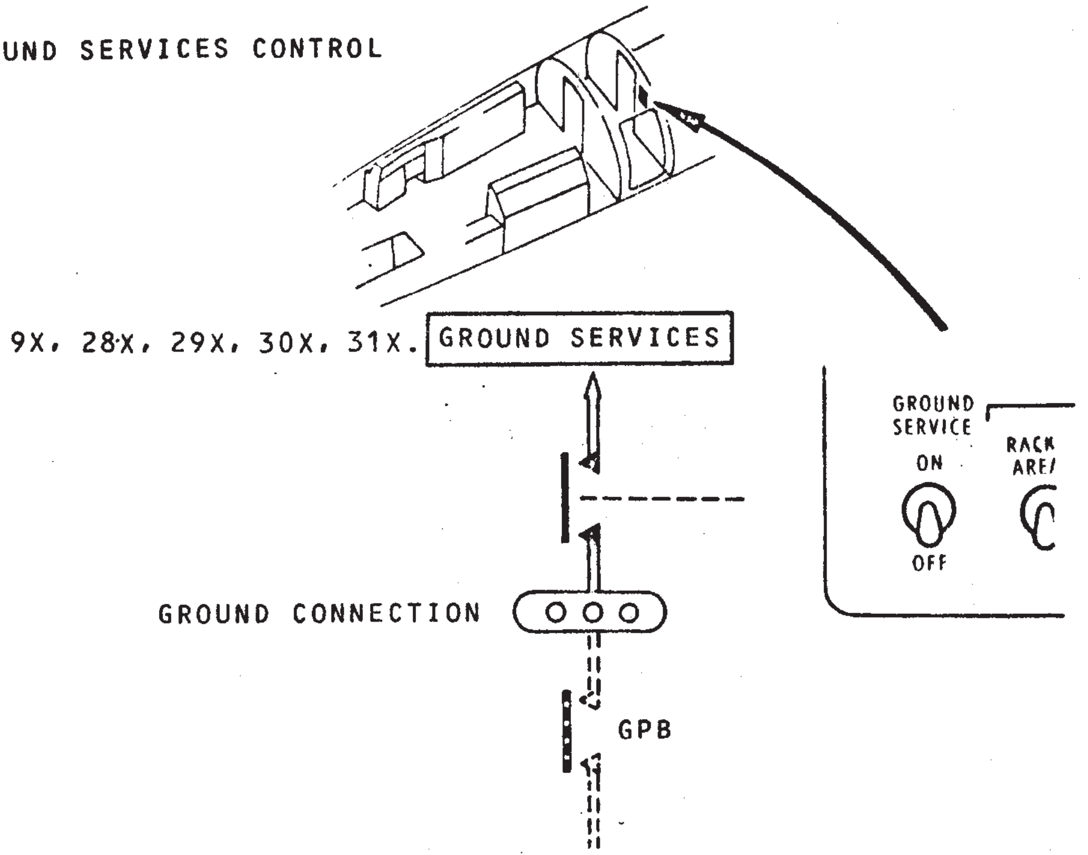
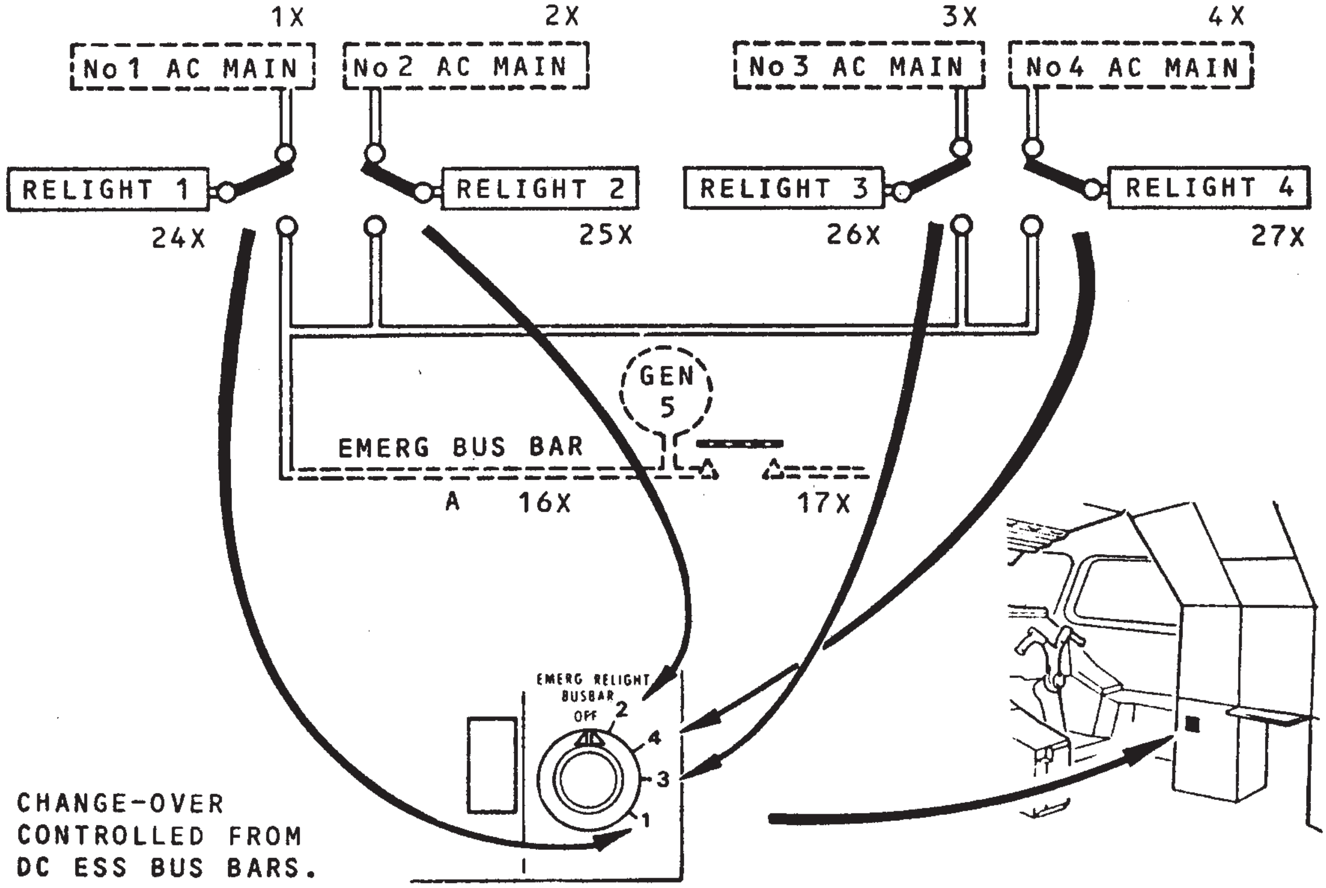
ANCILLARY BUSBARS

GROUND SERVICES CONTROL

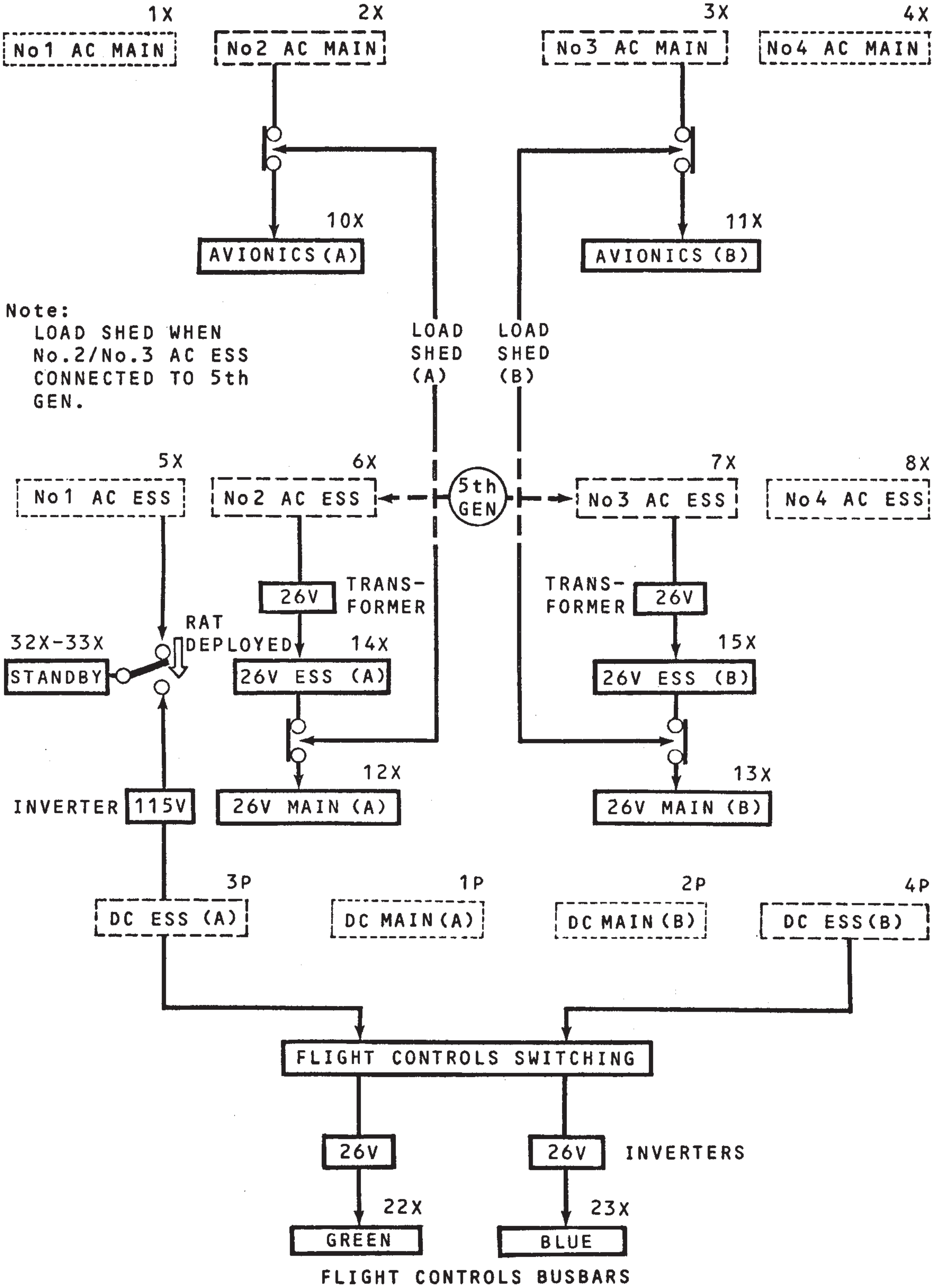


RELIGHT BUSBAR CONTROL



CHANGE-OVER
CONTROLLED FROM
DC ESS BUS BARS.

ELECTRONIC SUPPLIES



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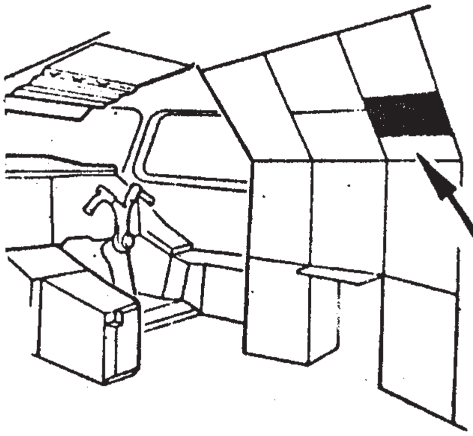
CONSTANT SPEED DRIVE



CSD OIL TEMPERATURE INDICATOR (4)

Left hand indicator shows the INLET temperature, the right hand indicator shows the DIFF (differential) between the inlet and outlet temperature.
Loss of electrical power to the instrument is indicated by a red and black striped flag.

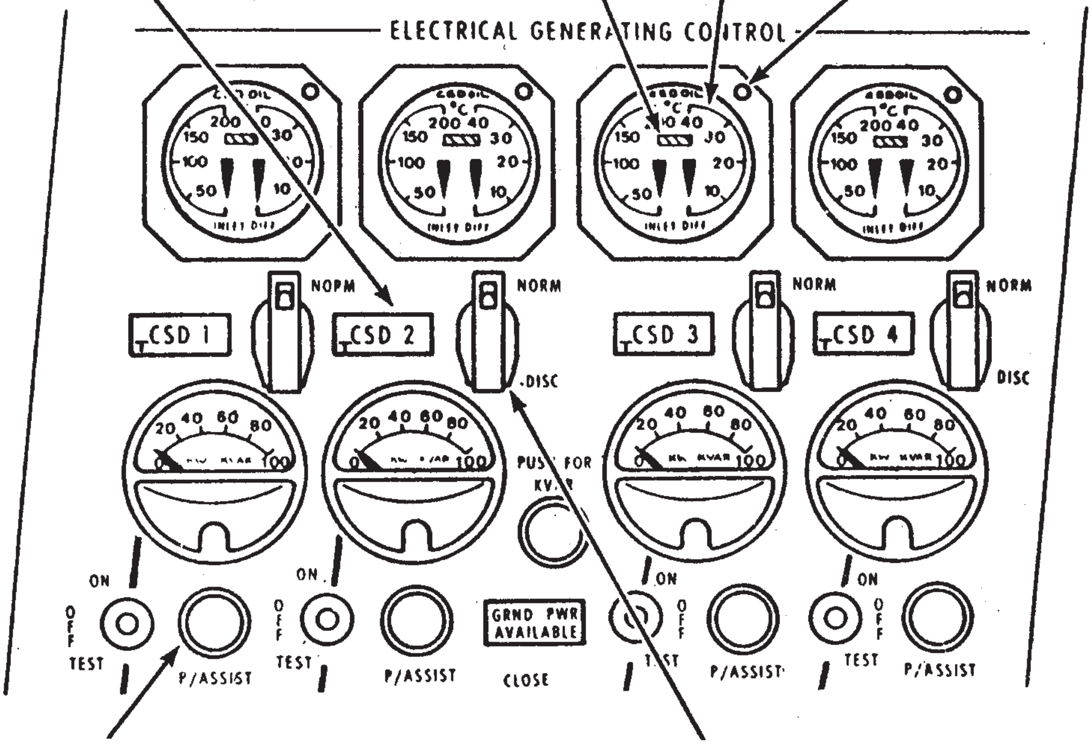
CSD LIGHT (Amber) (4)

On - indicates low oil pressure within the CSD. Accompanied by MWS ELEC light (amber) and audio (gong)

ELECTRICAL FAILURE FLAG

CSD OIL OVERTEMPERATURE LIGHT (Yellow) (4)

On-indicates a high oil temperature at the inlet to the CSD.



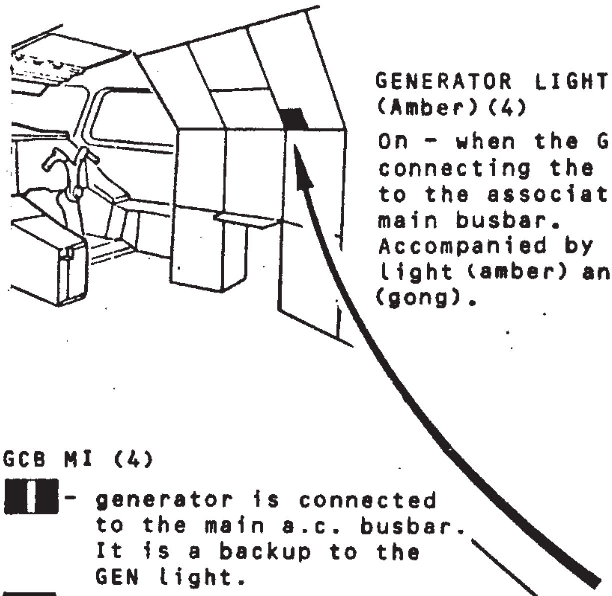
P/ASSIST PUSH BUTTON (4)

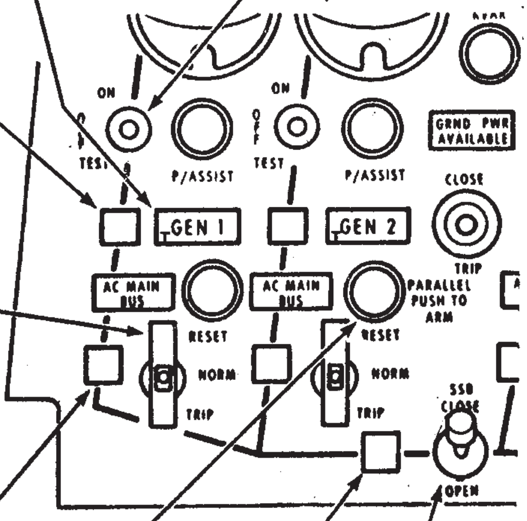
Press - to increase the generator frequency by 3Hz thus speeding up the self-paralleling of the generator to the busbar when the frequency difference is greater than 4 Hz or when the phase angles are different but no frequency difference exists.

CSD DISCONNECT SWITCH (4)

DISC - disconnects the CSD from the engine. The CSD speed drops and automatically disconnects the generator from its associated a.c. main busbar.

GENERATOR





GENERATOR LIGHT (Amber) (4)

On - when the GCB is not connecting the generator to the associated a.c. main busbar. Accompanied by MWS ELEC light (amber) and audio (gong).

GENERATOR SELECTOR (4)

ON - the output from the generator will be connected to the a.c. main busbar as soon as datum conditions are reached.
OFF - disconnects the generator from its associated a.c. main busbar and de-excites it.
TEST - controls the generator at normal volts and frequency but prevents it from connecting to its a.c. main busbar. The selector is spring loaded from TEST to OFF.

GCB MI (4)

▮ - generator is connected to the main a.c. busbar. It is a backup to the GEN light.
▬ - generator is disconnected from busbar.

BTB SELECTOR (4)

RESET - closes the BTB
NORM - automatically controls the connection of its a.c. main busbar to the other a.c. main busbars.
TRIP - opens the BTB and disconnects the associated a.c. main busbar from the others.

BTB MI (4)

▬ ▮

SSB MI

▬ ▮

PARALLEL PUSH TO ARM PUSH BUTTON LIGHT (Clear) (4)

Push to arm - the push button is in the out position. Light cycles dim and bright when the associated generator frequency is near to the busbar frequency. When the light is dim, the generator channel is nearest to synchronization with the other a.c. main busbars.
Push to disarm - the push button is in the in position.

SSB SWITCH

CLOSE - automatically parallels No.1 and No.2 generators with No.3 and No.4 generators when voltage and frequency are compatible.
OPEN - isolates No.1 and No.2 a.c. main busbars from No.3 and No.4 a.c. main busbars.

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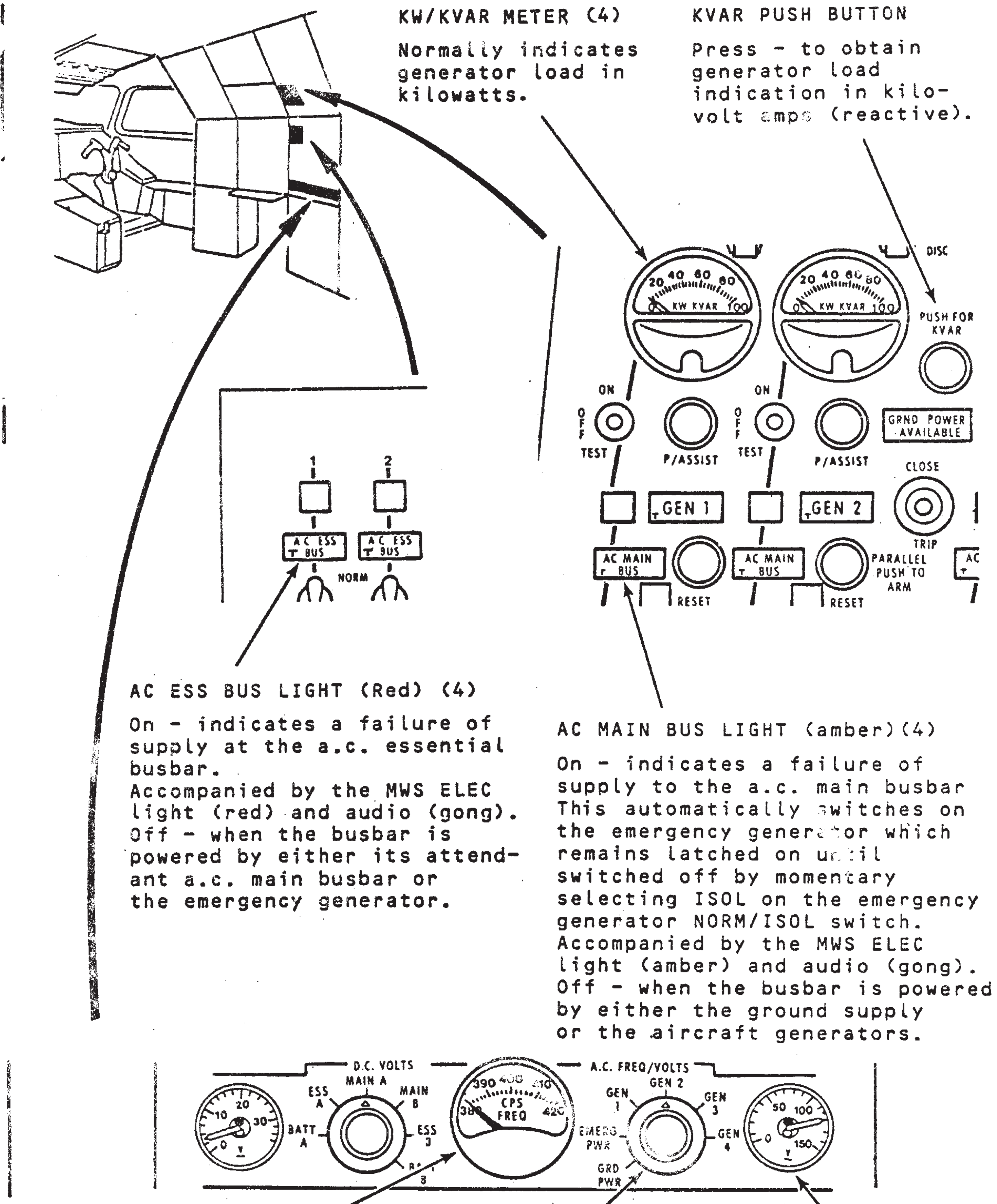
AC POWER



KW/KVAR METER (4)

Normally indicates generator load in kilowatts.

KVAR PUSH BUTTON

Press – to obtain generator load indication in kilo-volt amps (reactive).

AC ESS BUS LIGHT (Red) (4)

On – indicates a failure of supply at the a.c. essential busbar.
Accompanied by the MWS ELEC light (red) and audio (gong).
Off – when the busbar is powered by either its attendant a.c. main busbar or the emergency generator.

AC MAIN BUS LIGHT (amber)(4)

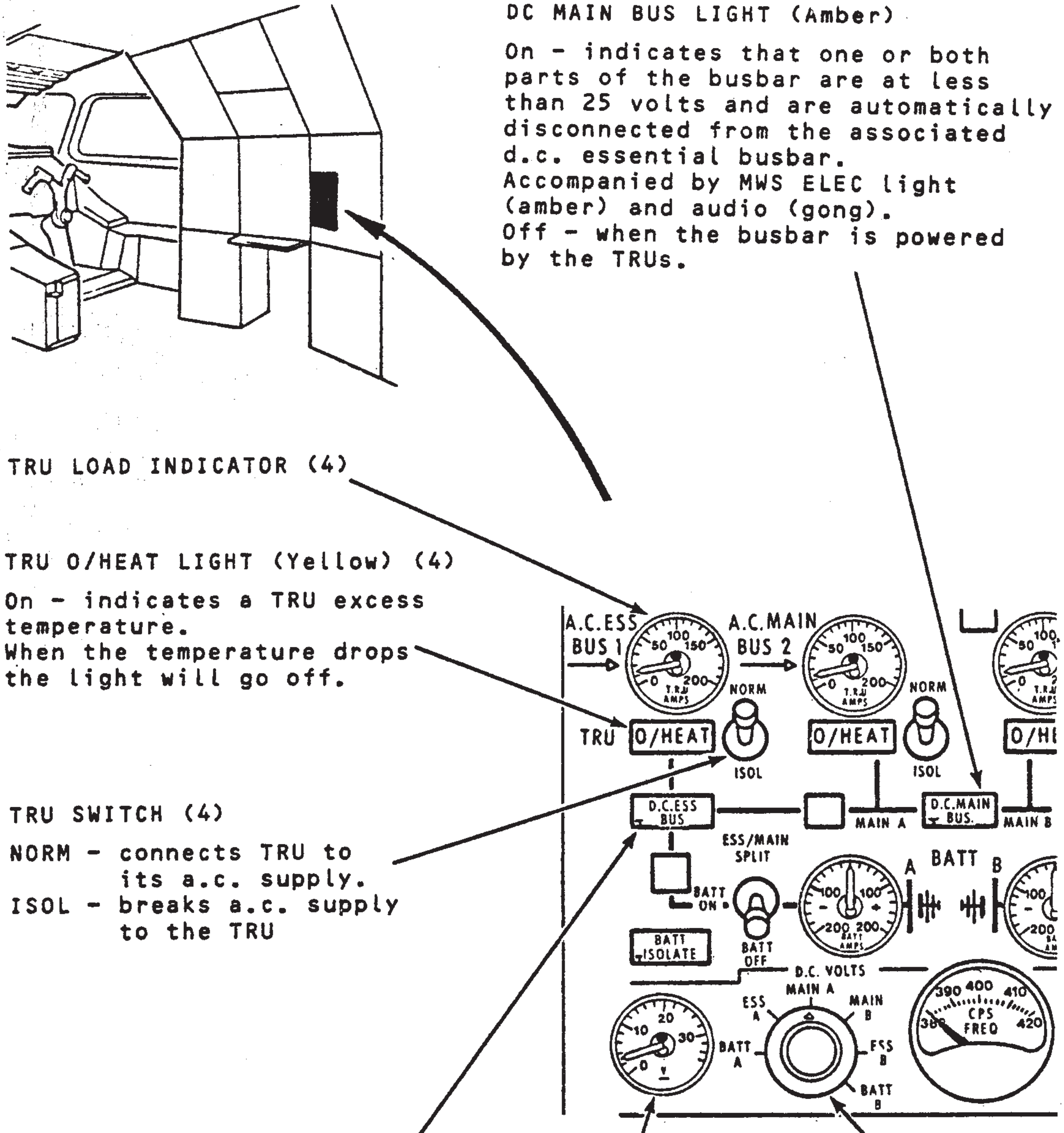
On – indicates a failure of supply to the a.c. main busbar This automatically switches on the emergency generator which remains latched on until switched off by momentary selecting ISOL on the emergency generator NORM/ISOL switch.
Accompanied by the MWS ELEC light (amber) and audio (gong).
Off – when the busbar is powered by either the ground supply or the aircraft generators.

FREQUENCY METER

AC FREQ/VOLTS ROTARY SELECTOR

AC VOLTMETER

DC POWER (Sheet 1 of 2)



DC MAIN BUS LIGHT (Amber)

On - indicates that one or both parts of the busbar are at less than 25 volts and are automatically disconnected from the associated d.c. essential busbar.
Accompanied by MWS ELEC light (amber) and audio (gong).
Off - when the busbar is powered by the TRUs.

TRU LOAD INDICATOR (4)

TRU O/HEAT LIGHT (Yellow) (4)

On - indicates a TRU excess temperature.
When the temperature drops the light will go off.

TRU SWITCH (4)

NORM - connects TRU to its a.c. supply.
ISOL - breaks a.c. supply to the TRU

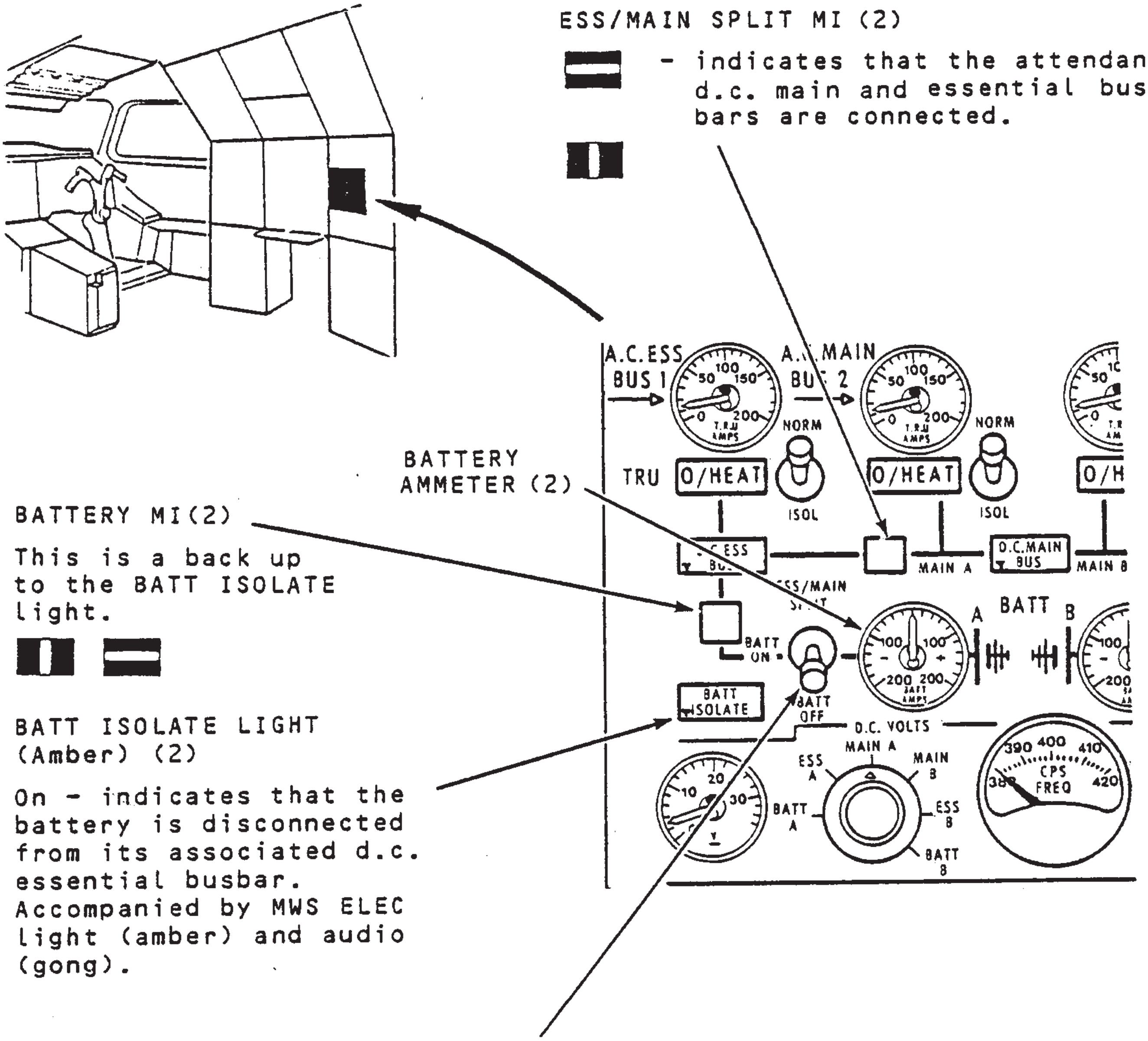
DC VOLTS ROTARY SELECTOR

DC VOLTMETER

DC ESS BUS LIGHT (Red) (2)

On - indicates that the d.c. essential busbar is not supplied.
Accompanied by MWS ELEC light (red) and audio (gong).
Off - when the busbar is powered by the TRUs or batteries.

DC POWER (Sheet 2 of 2)



ESS/MAIN SPLIT MI (2)

▬ - indicates that the attendant d.c. main and essential busbars are connected.

▮

BATTERY AMMETER (2)

BATTERY MI(2)

This is a back up to the BATT ISOLATE light.

▮ ▬

BATT ISOLATE LIGHT (Amber) (2)

On - indicates that the battery is disconnected from its associated d.c. essential busbar. Accompanied by MWS ELEC light (amber) and audio (gong).

BATTERY SELECTOR (2)

ESS/MAIN SPLIT - connects the battery to its associated d.c. essential busbar and opens the associated d.c. ess/main isolate breaker, thus disconnecting the d.c. main and d.c. essential busbars from each other.

BATT ON - connects the battery to its associated d.c. essential busbar 3P or 4P and arms the associated d.c. essential/main isolate breaker thus connecting the d.c. main and d.c. essential busbars together.

BATT OFF - disconnects the battery from its associated d.c. essential busbar 3P or 4P and arms the associated d.c. essential/main isolate breaker thus connecting the d.c. main and d.c. essential busbars together.

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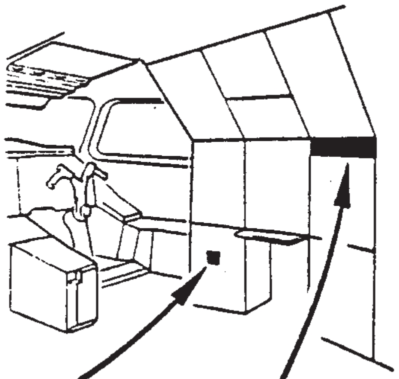
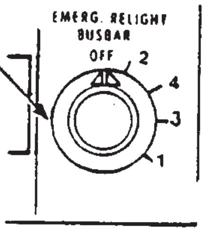
(Unchanged)

ESSENTIAL AC (Sheet 1 of 2)

EMERGENCY RELIGHT BUSBAR ROTARY SELECTOR

2,4,3, and 1 - the emergency generator powers the emergency relight busbars 25X,27X,26X and 24X respectively to operate the right hand igniter, the start pump and the main engine feed pump of the associated collector tank.

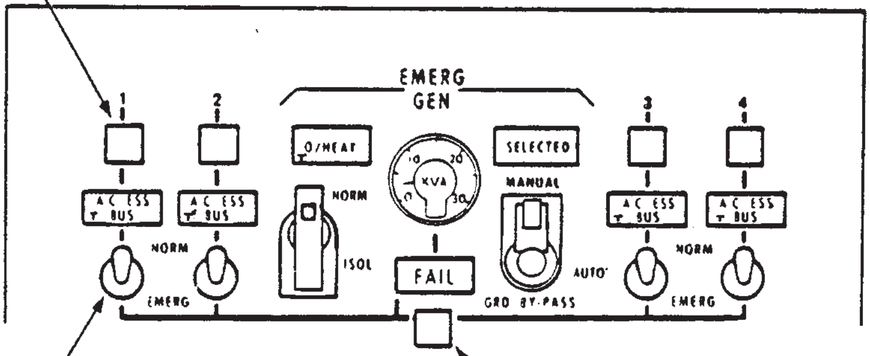




AC ESS BUS MI (4)

▬

▮ - indicates that the a.c. essential busbar is connected to its associated a.c. main busbar.



AC ESSENTIAL BUSBAR NORM EMERG SWITCH (4)

NORM - connects the a.c. essential busbar 5X,6X,7X or 8X respectively to its associated a.c. main busbar.
Allows the emergency generator to revert to automatic control.

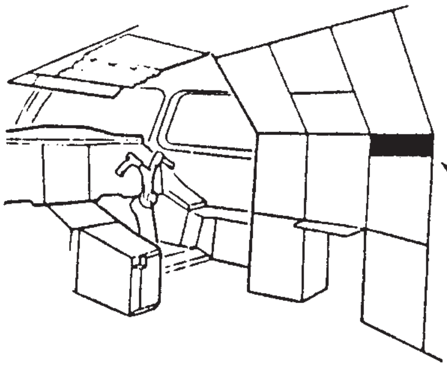
EMERG - selects the emergency generator on and disconnects the a.c. essential busbar from the associated a.c. main busbar and connects it to the emergency generator output busbars 16X or 17X.
- No. 2 switch, sheds the avionics A busbar 10X and the 26V a.c. main A busbar 12X.
- No. 3 switch, sheds the avionics B busbar 11X and the 26V a.c. main B busbar 13X.

AUTO SHED BREAKER MI

▬ - indicates that the emergency generator can be connected to No. 3 and No. 4 a.c. essential busbars 7X and 8X via busbar 17X.

▮ - indicates that there is no connection between the emergency generator directly connected a.c. emergency busbar 16X and the sheddable a.c. emergency busbar 17X. Is automatically opened when No.1 and No.2 engine failure is sensed.

ESSENTIAL AC (Sheet 2 of 2)



EMERG GEN SELECTOR

MANUAL - providing the EMERG GEN NORM/ISOL switch at NORM, causes the emergency generator to run by-passing the automatic switching system and regardless of weight switch position. To select MANUAL, move the gate and lift the lock toggle selector.

AUTO - with the selector at this position and the EMERG GEN NORM/ISOL switch at NORM, the emergency generator is armed to operate when any a.c. main busbar loses its supply or when No. 1 and No. 2 engines fail while airborne.

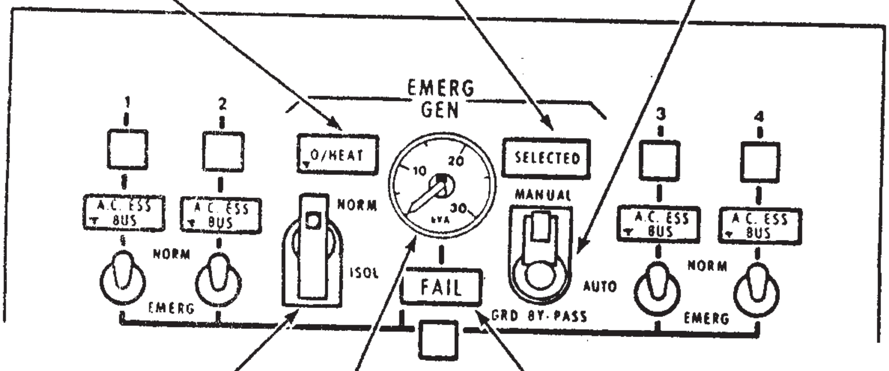
GRD BY-PASS - by-passes the weight switch inhibit circuit of the emergency generator.

EMERG GEN O/HEAT LIGHT (Red)

On - indicates an emergency generator carcase or bearing high temperature. Accompanied by MWS ELEC light (red) and audio (gong).

EMERG GEN SELECTED LIGHT (Blue)

On - indicates that hydraulic power has been selected to drive the generator.



EMERG GEN LOAD INDICATOR

Reads output of the emergency generator.

EMERG GEN NORM/ISOL SWITCH

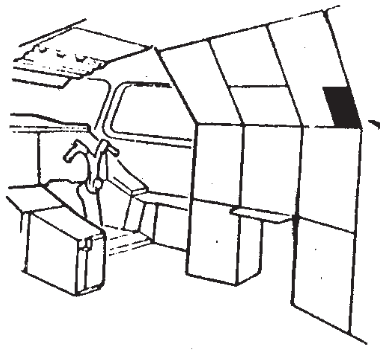
NORM - arms the emergency generator for subsequent operation.

ISOL - switches off the emergency generator hydraulic supply and the O/HEAT light supply.

EMERG GEN FAIL LIGHT (Yellow)

On - indicates that the emergency generator has been selected to run but is outside its operating limits with or without de-excitation.
Pressing the light resets the excitation circuit if it has been de-excited.

EXTERNAL POWER



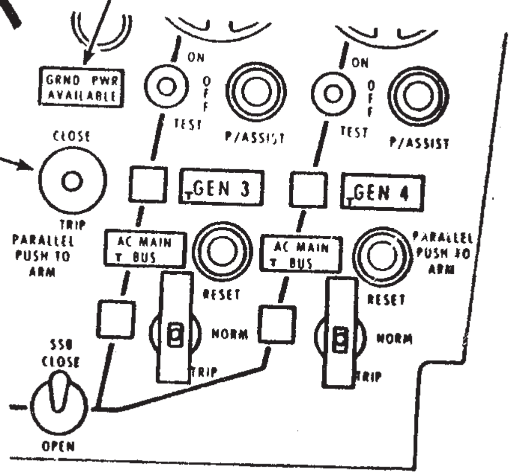
GROUND PWR AVAILABLE LIGHT
(White)

On - indicates that the ground supply is of the required voltage, frequency and direction of rotation and is available for connection to the busbars.

GROUND POWER SWITCH

CLOSE - closes the ground power breaker and directs ground supply to the split system breakers, the bus-tie breakers, and hence the main a.c. busbars, 1X, 2X, 3X, 4X. On engine shut down, CLOSE arms the ground power breaker circuit. The ground supply will be connected automatically to the busbars as the last generator is disconnected.

TRIP - disconnects the ground supply from the aircraft busbars.



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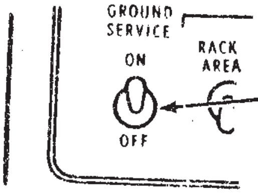
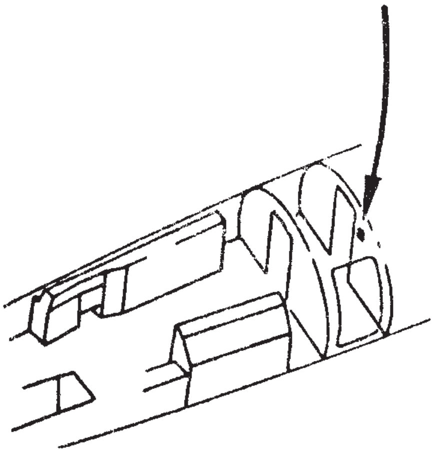
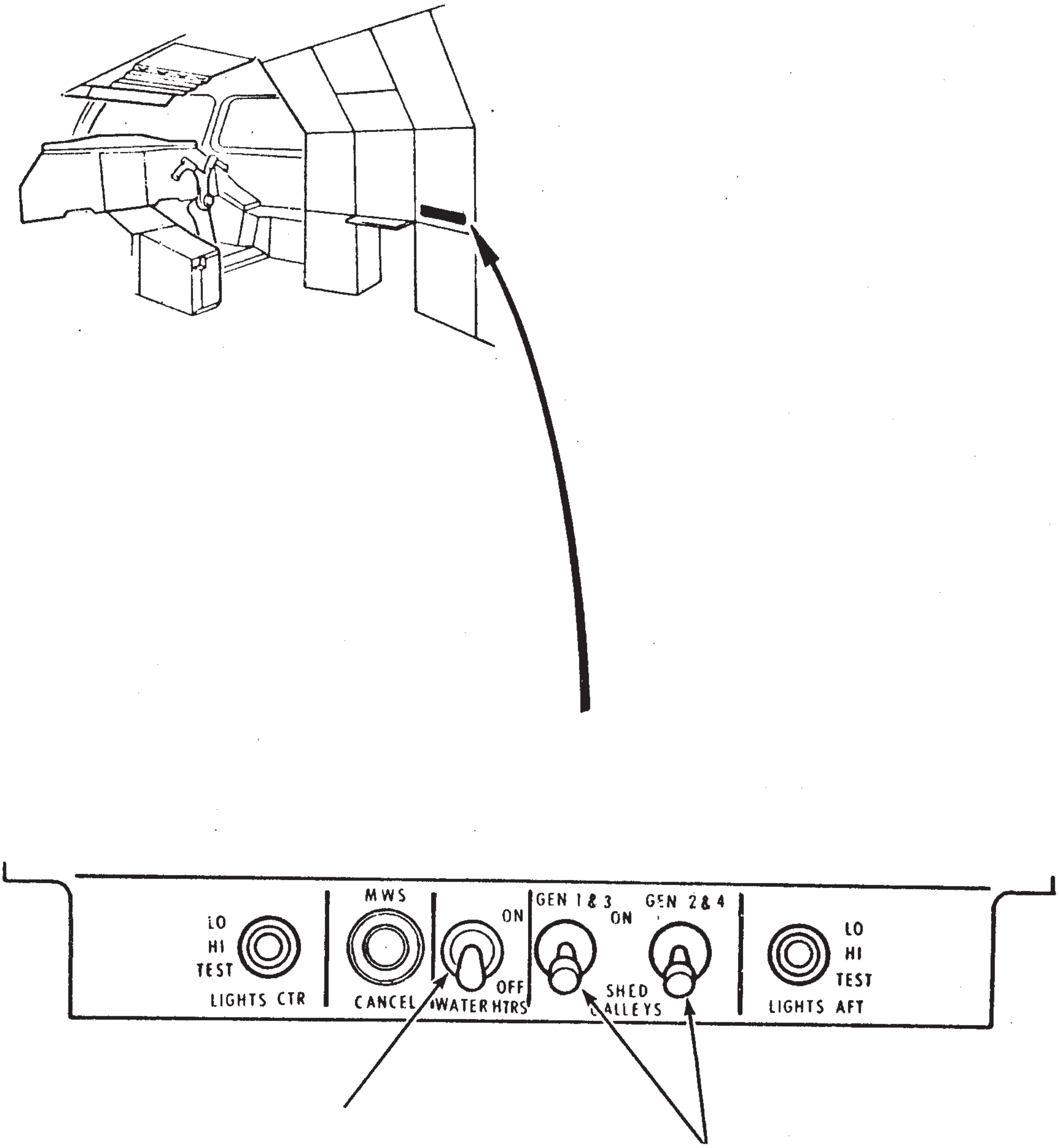


GROUND SERVICE SWITCH

ON - directs a supply through the ground power busbar 9X to supply:-
- Directly.
  Vacuum cleaner sockets.
  Refuel control and indicators.
  Vestibule, cabin and toilet fluorescent lights.
- Via ground/flight changeover relays, ground/flight busbars 28X and 29X.
  Drain mast heaters.
  Navigation and anti-collision lights.
  Toilet, cabin, flight deck and aft freight hold lights.
- Via transformers, ground busbars 30X and 31X.
  Emergency brake accumulator pressure and brake pressure instruments.
  Water system anti-ice heating.
  Forward freight hold, toilet, boarding and service lights.
  Refuel panel lights.



GALLEY EQUIPMENT CONTROLS



WATER HEATERS SWITCH

GALLEYS SWITCH

Controls supply to the galley equipment.

The rear galleys are off loaded when the GROUND HYDRAULIC CHECK OUT PUMPS are on.

Chapter 7

EMERGENCY EQUIPMENT

(ATA CHAPTER 25)

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Description and Operation 07.00.05

Oxygen

Description 07.01.01

Schematics

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- Crew Mask/Regulators 07.02.02
- Crew and Pax Minimum Oxygen Pressure 07.02.03

Controls and Indicators

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- Oxygen Mask 07.03.02
- Passenger System Control Panel 07.03.03

Escape Equipment

Controls and Indicators

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- Intermediate and Rear Vestibules 07.04.02
- Slide and Raft Deployment (Emergency Landing) 07.04.03
- Slide and Raft Deployment (Ditching) 07.04.04
- Escape Ropes 07.04.05
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- Moving Forward Slide/Raft to Intermediate Door Exit 07.04.11
- Liferaft Type 36UA Mk 1 07.04.12

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EMERGENCY EQUIPMENT

GENERAL

The emergency equipment section describes and illustrates the systems and equipment which are essential to the safety of passengers and crew during adverse operational conditions. These include the emergency evacuation alert system, emergency equipment locations, passenger and crew oxygen system and escape equipment.

EMERGENCY EVACUATION ALERT SYSTEM

The emergency evacuation alert system provides aural and visual warnings for the flight crew and cabin staff.
It also permits the cabin staff at the forward door to operate the flight compartment visual warning by remote control.

The system consists of an audio (bleeper) warning and a flashing light in the flight compartment and in each of the three vestibules. The system is automatically actuated at all stations whenever the arming and control switch in the flight deck is set to the ON position or, provided the control switch is set in the ARM position whenever the cabin crew's ON/OFF switch is set to ON. The system cannot be actuated when the arming and control selector is in the OFF position. However, if the cabin crew's ON/OFF switch in the forward vestibule is set to ON and the flight compartment control switch is in the OFF position, only the flight compartment flashing light will be actuated. The audio warnings may be individually shut off at each applicable station.

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EMERGENCY AND SURVIVAL EQUIPMENT STOWAGE LOCATION

A. Flight Compartment

Torch:

Stowed at the flight engineer's station.

Smoke goggles:

One pair at each position:-
Captain - in the LH side console.
First Officer - in the RH side console.
Flight Engineer - at his station.

Portable oxygen equipment:

One mask and one pack in the miscellaneous equipment rack.

Fire extinguisher: (CO_2)
Asbestos gloves:
Fire axe:

One extinguisher mounted on the miscellaneous equipment rack, one pair of gloves in a rack compartment and one axe on rack 215.

Escape ropes:
One rope is stowed in each side console

Life jackets:
Five life jackets are stowed in the miscellaneous equipment rack for the use of the flight crew.

B. Passenger Cabin

Fire Extinguishers, CO_2:
Fwd LH door, Centre LH door and Rear RH door.

Fire Extinguisher, Water:
Centre RH door.

Ditching Lines:
One on each side of the aircraft in the centre amenity stowages.

Escape Rope:
One rope is stowed in the forward amenity stowage.

Escape Slides:
One on each door. Those at the forward passenger door and at the centre doors are slide/rafts.

Slide/Rafts:
One at the forward passenger door and one at each intermediate door. The associated canopies are packed with the relevant emergency packs.

Life raft:
One at the rear of the aft cabin. (RH side)

Emergency Packs:
One in the forward amenity stowage. Two at the rear of the forward cabin. One supplementary pack at rear of rear cabin on left hand side.

Radio Beacon:
One at the rear of the forward cabin (RH) and one at the rear of the aft cabin. (LH)

Life jackets:

Passenger - one under each passenger seat
Infant - six in the RH rear amenity stowage. (L.H. rear amenity Post Mod)
Cabin crew - one in each amenity stowage and one on the RH side of the forward vestibule, adjacent to RH Stewards seat
Demonstration- one in the forward and two in the RH centre amenity stowages.

First aid kits:
Three kits; one each in the forward, RH centre and RH rear amenity stowages.

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EMERGENCY EQUIPMENT

Megaphone:
- One in fwd LH supplementary galley (No.4) (Pre mod)
- One in rear LH supplementary galley (No.5) (Pre mod)
- One at fwd L.H. door. (Post Mod).
- One at rear R.H. door. (Post Mod).

Fire Axe:
- One in rear RH stowage.

Crew Portable oxygen set:
- Fwd LH door and Fwd RH door
- Centre LH door and Centre RH door.
- Two at Rear RH door.

ESCAPE SLIDES AND SLIDE/RAFTS

Inflatable slides and slide/rafts are used in the evacuation of the aircraft. They can be separated from the aircraft and the slide/rafts can be converted to life rafts. The slides may be used as aids to floating but are not intended to be used as free rafts. There is sufficient rated capacity in the slide/rafts and life raft for all the occupants of the aircraft. If the largest slide/raft cannot be used all the occupants can be accommodated within the overload capacity of the remainder and that of the liferaft. Should evacuation be possible on one side of the aircraft only, the available overload capacity of the slide/rafts and the life raft capable of being launched from either side is sufficient for all occupants. The forward left hand slide/raft pack can be removed from its location, taken through either centre doorway and opened and deployed in this position.

LIFE RAFT AND EMERGENCY PACK

The 36 person life raft has an emergency pack stowed within the raft valise. The pack contains rations and other survival equipment. The raft with pack is released from the stowage by use of quick release straps and is launched through either of the aft cabin doorways. (A supplementary emergency pack is located near the raft).

SLIDE/RAFT EMERGENCY PACKS

One emergency pack is carried for each of the three slide/rafts and contains rations and other survival equipment for occupants of the appropriate slide/rafts. Each pack contains a canopy for its slide/raft.

MEGAPHONES

These are hand held, battery operated units.

SEARCH AND RESCUE RADIO BEACONS

Two emergency radio beacons are carried in the passenger cabin for use in the event of a forced landing or ditching. Each beacon is a self-buoyant, dual frequency, battery operated, radio distress beacon transmitter.

ESCAPE ROPE IN FWD AMENITY STOWAGE

This rope can be attached to the doorway grab handle at either the forward passenger or service doors. It permits a crew member to descend to the ground in an emergency evacuation when wind conditions limit the normal deployment of slides, some of which can be made usable by ground handling.

EMERGENCY LIGHTING

There are two facilities for control of emergency lighting, a selector on the rear overhead panel and a switch on the forward steward's panel. With the LIGHTS EMERG selector at ARM all aircraft emergency lights will come on in the event of a failure of the d.c. essential busbar A. With selector or switch at ON emergency lighting is selected.

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OXYGEN

GENERAL

Two emergency oxygen systems are provided, one for the flight crew and one for the passengers and cabin crew. The two systems are completely independent and employ gaseous oxygen from storage cylinders. There is however an interconnect facility which allows the flight crew system to draw on the cabin supply. In addition portable cylinders are located in the flight deck and in the cabin.

DESCRIPTION

CREW SYSTEM

The flight crew oxygen system is the pressure breathing, diluter-demand type. Oxygen from a high pressure storage cylinder is reduced to a lower pressure and supplied to the crew stations.

A regulator supplies the oxygen mask on demand up to a cabin altitude of 32,000 feet. Above this altitude the oxygen mask is supplied with undiluted oxygen at a progressively increasing pressure according to the cabin altitude, irrespective of the regulator switch position.

A quick donning oxygen mask is supplied for each crew member. It has an individual stowage box and is automatically supplied with oxygen after withdrawal.

PASSENGER SYSTEM

Three interconnected bottles supply the cabin through a passenger system control panel. A pressure regulator supplies oxygen to the passenger distribution system at a normal pressure of 40 psi and an emergency pressure of 90 psi.

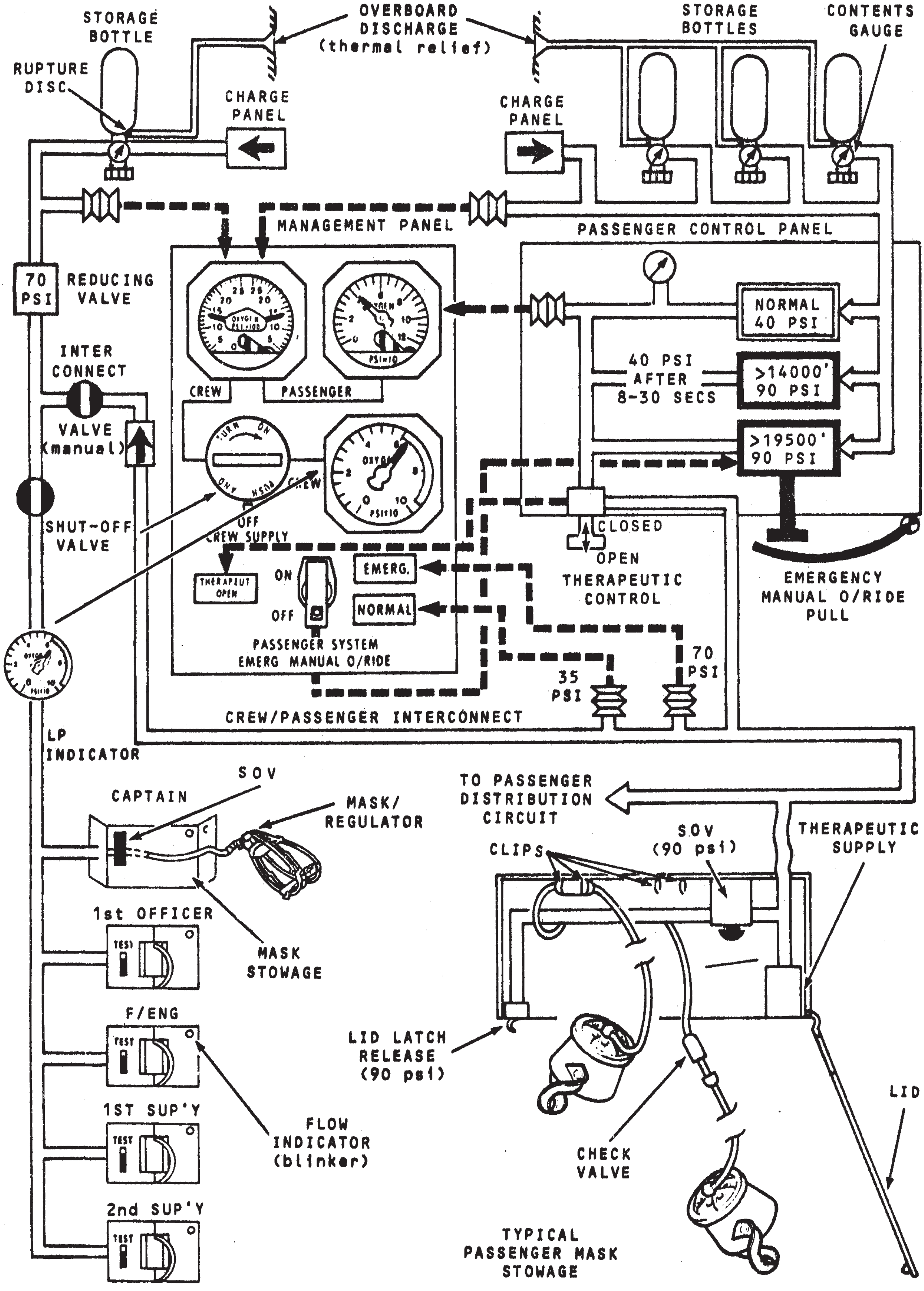
The normal pressure of 40 psi is manually selected and used for therapeutic supply and is supplied to the passengers via a therapeutic supply point in the passenger mask stowage.

The emergency pressure of 90 psi is automatically selected when the cabin altitude exceeds 14,000 feet and causes the automatic presentation of all the mask units in the cabin. Oxygen will flow continuously when the mask is pulled to the users face. There is a twin mask unit and a triple mask unit at each seat row a twin mask unit in each toilet and a mask at each cabin crew station.

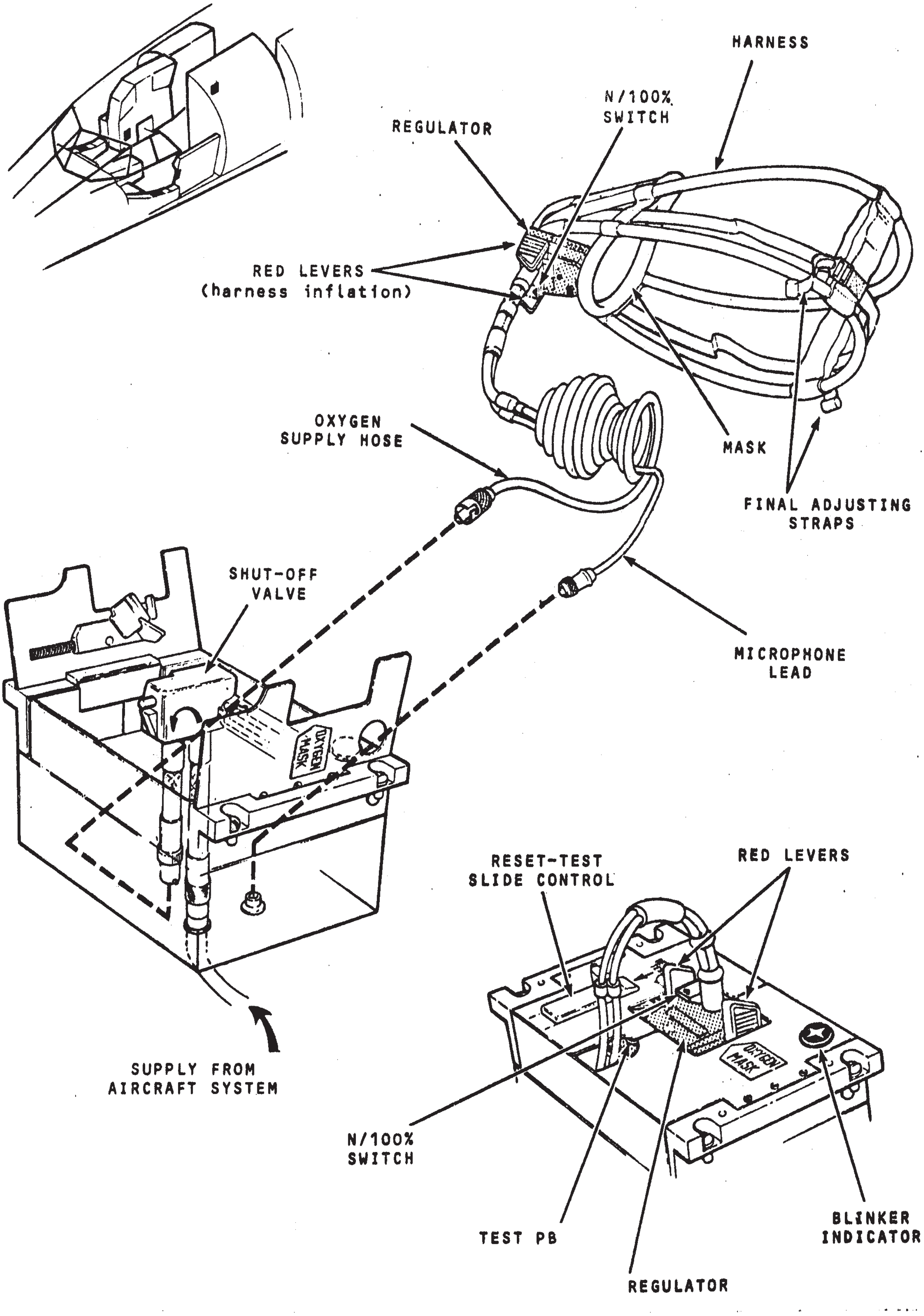
PORTABLE OXYGEN

One portable oxygen set is positioned in the flight deck and one set for each cabin crew member is positioned in the cabin.

OXYGEN SYSTEM



OXYGEN SYSTEM



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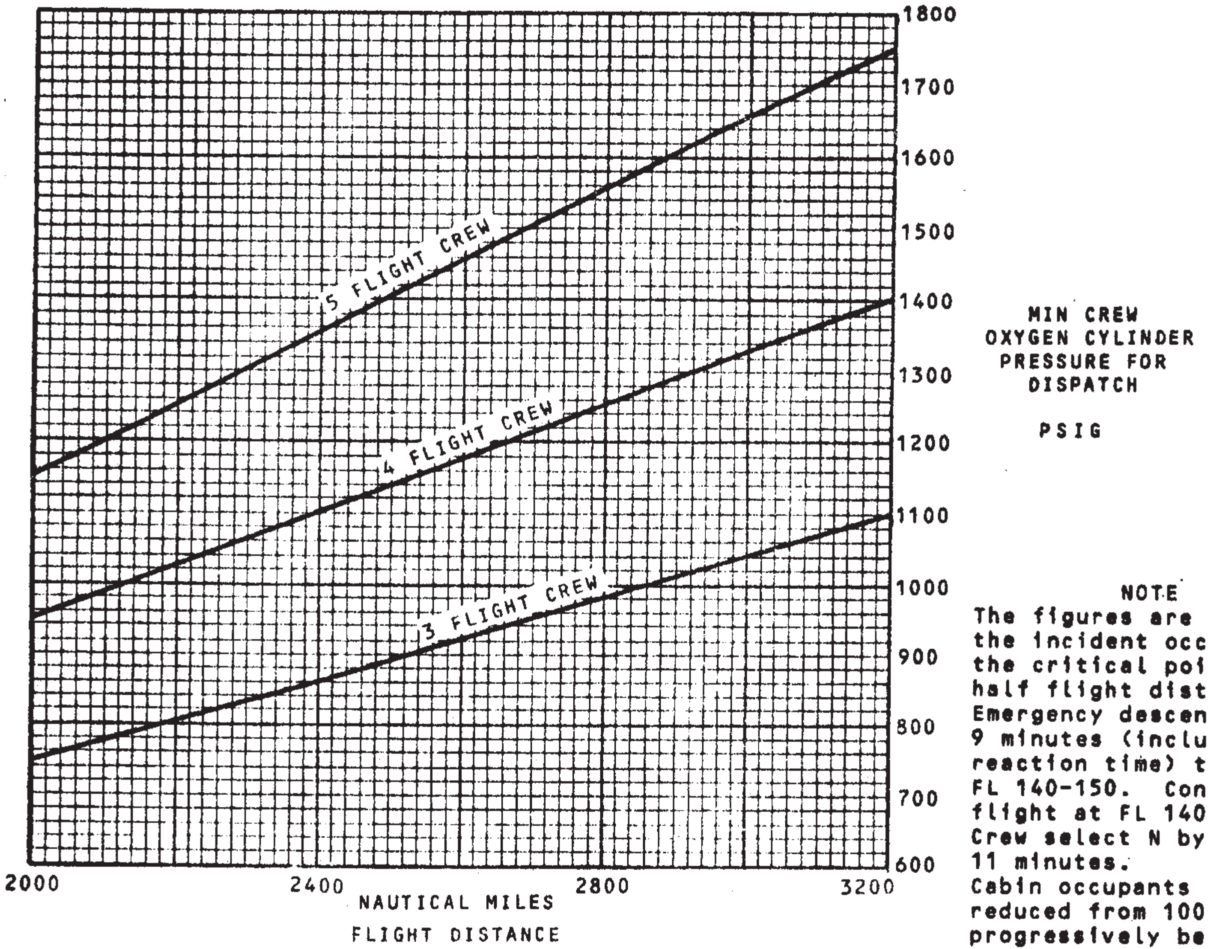
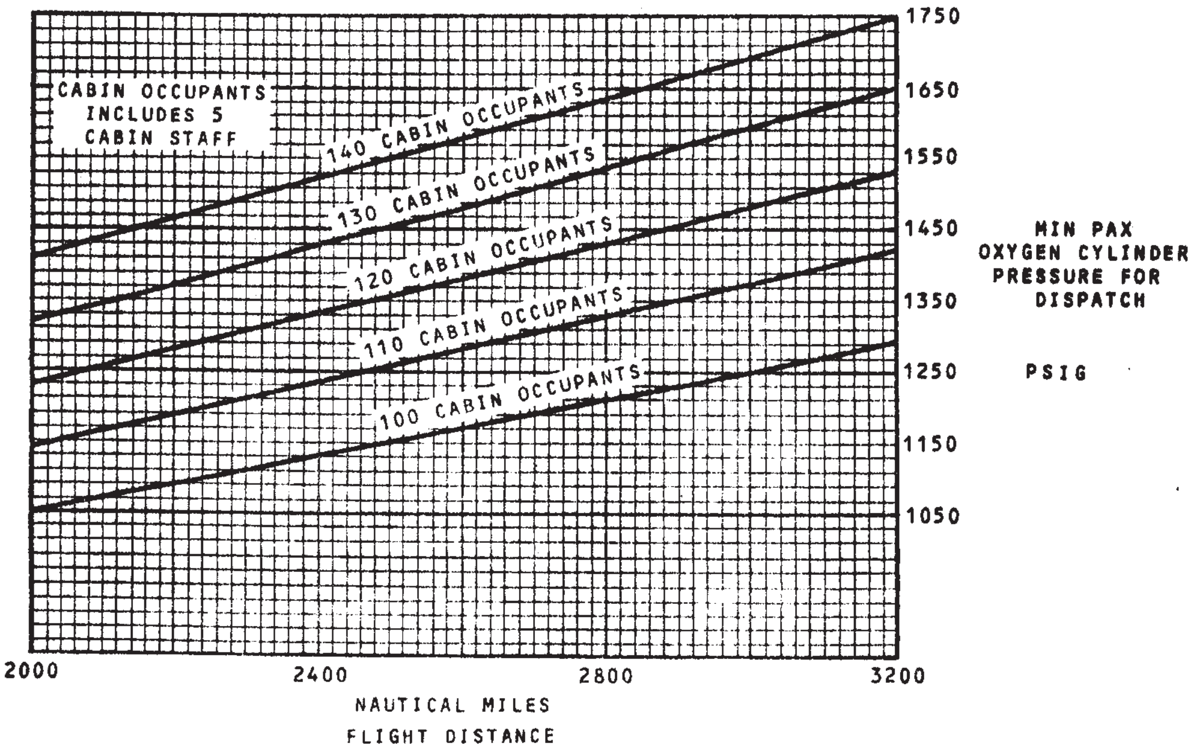
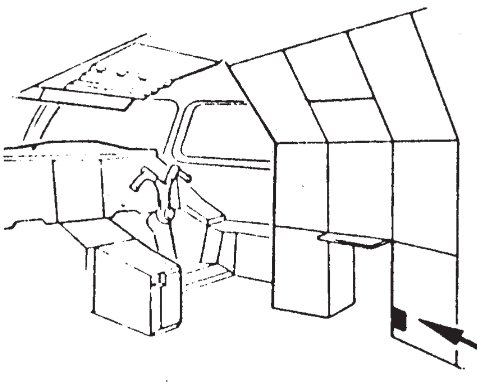
CREW AND PAX MINIMUM OXYGEN PRESSURE



NOTE
The figures are based on:- the incident occurring at the critical point ie half flight distance.
Emergency descent time 9 minutes (including reaction time) to FL 140-150. Continued flight at FL 140-150.
Crew select N by plus 11 minutes.
Cabin occupants oxygen reduced from 100% to 15% progressively between plus 9 minutes and plus 13 minutes.
2% of passengers on therapeutic oxygen.



OXYGEN PANEL

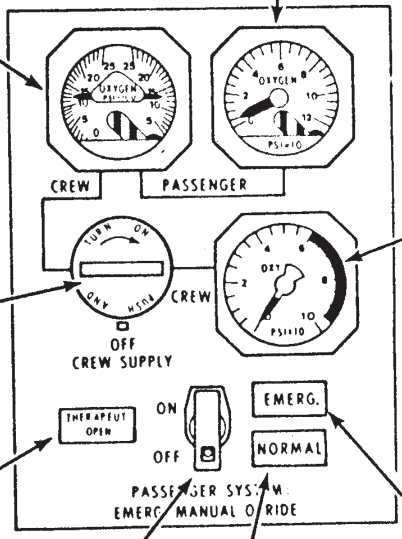


PASSENGER SUPPLY PRESSURE INDICATOR

Shows the pressure upstream of the therapeutic valve. The failure flag with a red background and black stripes indicates a loss of electrical power supply in the supply pressure indicator.

DUAL PRESSURE INDICATOR

Left Hand pointer - shows crew system bottle pressure.
Right Hand pointer - shows passenger system bottles pressure.
The failure flag with a red background and black stripes indicates a loss of electrical power supply in the dual pressure indicator.



CREW DELIVERY PRESSURE GAUGE

Indicates a direct pressure in the crew delivery system

CREW SUPPLY ROTARY SELECTOR

OFF - isolates the crew distribution circuit from the oxygen bottle supply system

THERAPEUT OPEN LIGHT (Green)

On - indicates that the therapeutic supply valve is open.

EMERG LIGHT (Yellow)

On - indicates that the pressure in the passenger mask supply line exceeds 70 psi.
Accompanied by
FASTEN SEAT BELTS signs
RETURN TO SEATS signs
NO SMOKING signs and an audio tone in the public address.

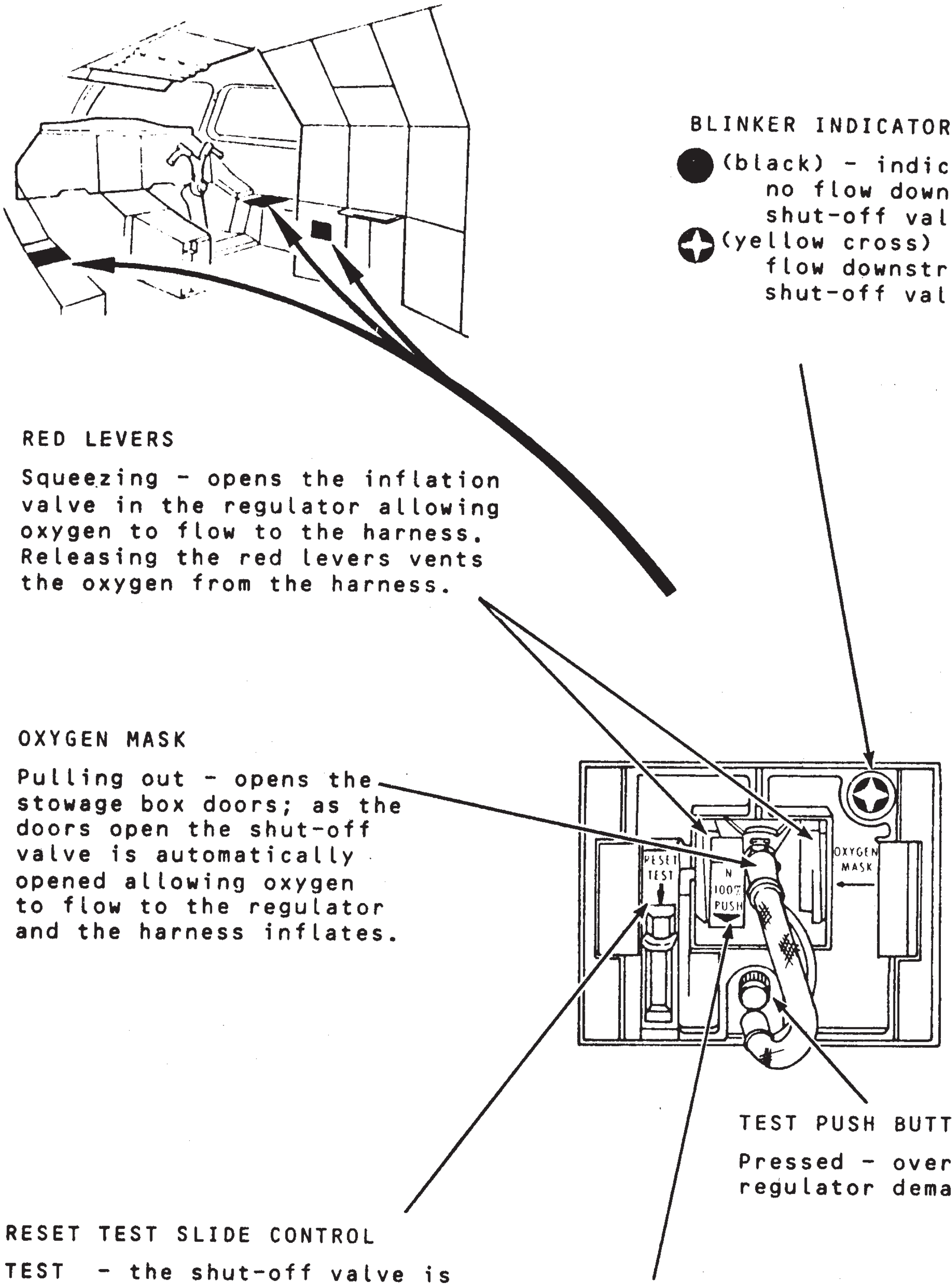
PASSENGER SYSTEM EMERG MANUAL O/RIDE SWITCH.

ON - electrically overrides the barometric control of the regulator thus pressurizing the passenger mask supply line at emergency pressure. Guarded in the OFF position.

NORMAL LIGHT (Green)

On - indicates that the pressure in the passenger mask supply line exceeds 35 psi.

OXYGEN MASK



BLINKER INDICATOR

● (black) - indicates there is no flow downstream of the shut-off valve.

⊕ (yellow cross) - indicates flow downstream of the shut-off valve.

RED LEVERS

Squeezing - opens the inflation valve in the regulator allowing oxygen to flow to the harness. Releasing the red levers vents the oxygen from the harness.

OXYGEN MASK

Pulling out - opens the stowage box doors; as the doors open the shut-off valve is automatically opened allowing oxygen to flow to the regulator and the harness inflates.

TEST PUSH BUTTON

Pressed - overrides the regulator demand function.

RESET TEST SLIDE CONTROL

TEST - the shut-off valve is opened allowing oxygen to flow to the regulator.

RESET - the shut-off valve is closed. Spring returned to the RESET position

At the upper part of the RESET-TEST slide control a white area, when completely masked, indicates the correct closure of the shut-off valve.

N (Normal) - 100% SWITCH

N - the regulator supplies the oxygen mask on demand up to a cabin altitude of 32,000 ft. Above this altitude the oxygen mask is supplied with undiluted oxygen at a progressive increase in pressure according to the cabin altitude, irrespective of the N-100% switch position.

100% - the regulator supplies undiluted oxygen at any altitude.

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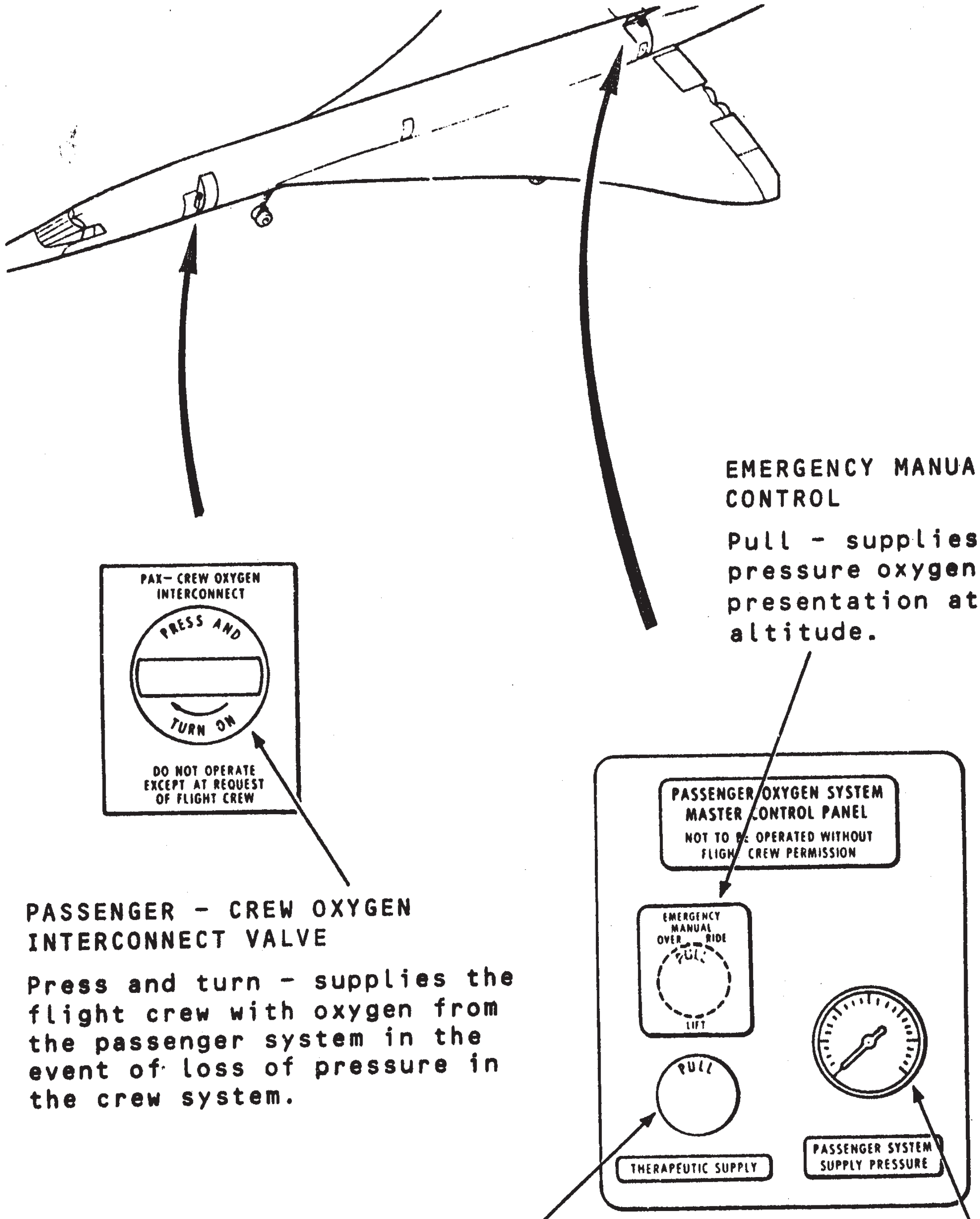
PASSENGER SYSTEM CONTROL PANELS


PAX– CREW OXYGEN INTERCONNECT
PRESS AND
TURN ON
DO NOT OPERATE EXCEPT AT REQUEST OF FLIGHT CREW
PASSENGER OXYGEN SYSTEM MASTER CONTROL PANEL
NOT TO BE OPERATED WITHOUT FLIGHT CREW PERMISSION
EMERGENCY MANUAL OVERRIDE
PULL
LIFT
PULL
THERAPEUTIC SUPPLY
PASSENGER SYSTEM SUPPLY PRESSURE

EMERGENCY MANUAL OVERRIDE CONTROL

Pull - supplies emergency pressure oxygen and mask presentation at any cabin altitude.

PASSENGER - CREW OXYGEN INTERCONNECT VALVE

Press and turn - supplies the flight crew with oxygen from the passenger system in the event of loss of pressure in the crew system.

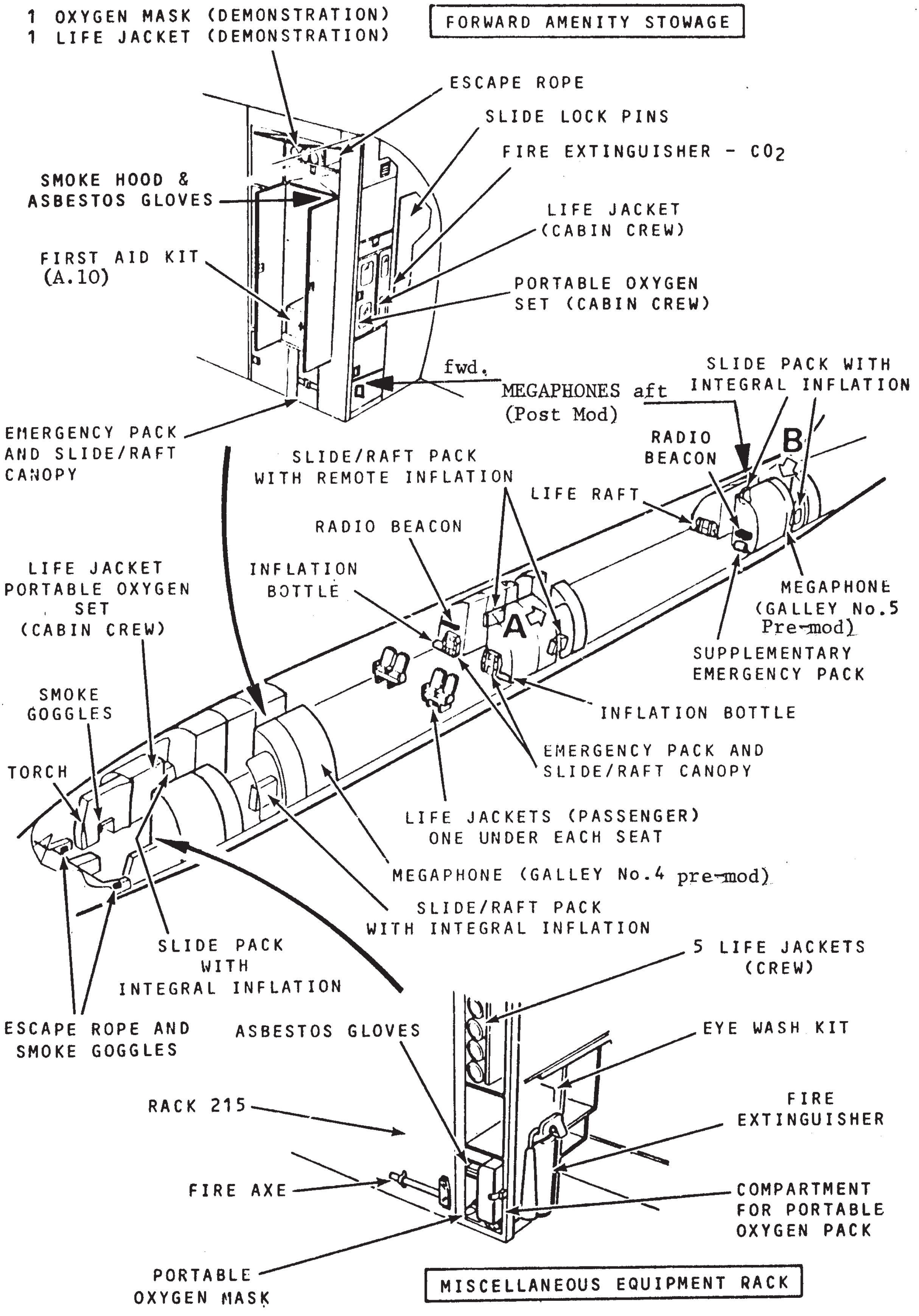
THERAPEUTIC VALVE CONTROL

Pull - supplies therapeutic oxygen in normal flight conditions.
Push - shuts off supplies when requirement for therapeutic oxygen has ceased.

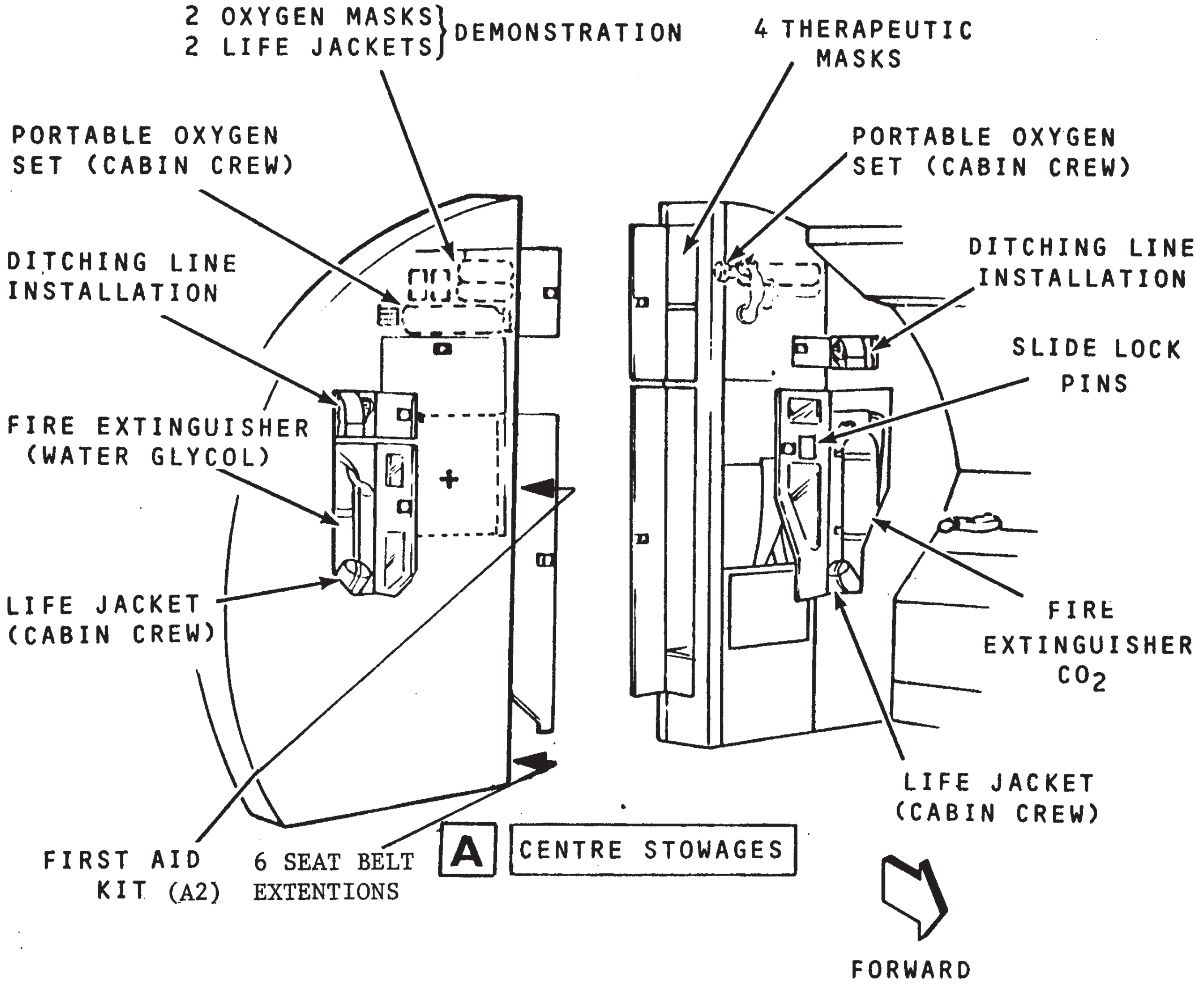
PASSENGER SYSTEM SUPPLY PRESSURE INDICATOR

Indicates passenger ring main pressure available.

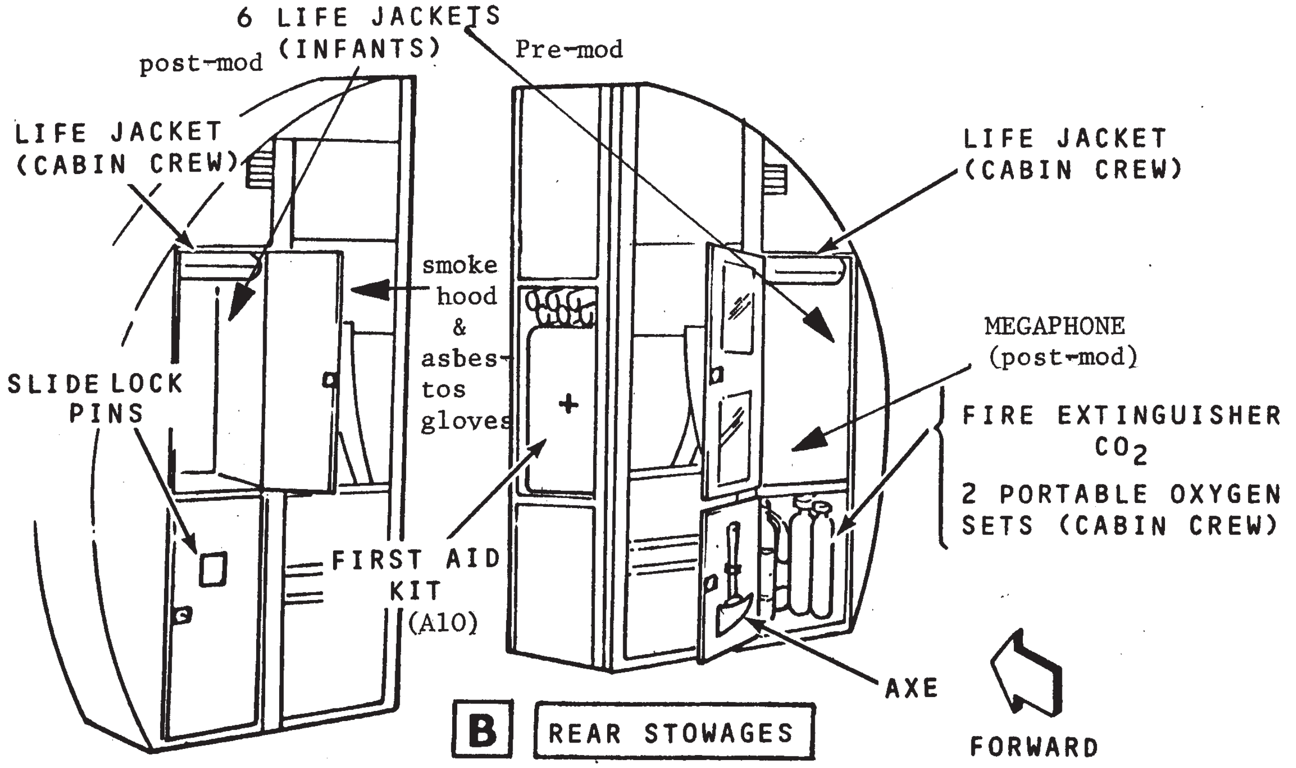
FLIGHT COMPARTMENT AND FORWARD VESTIBULE


1 OXYGEN MASK (DEMONSTRATION)
1 LIFE JACKET (DEMONSTRATION)
FORWARD AMENITY STOWAGE
ESCAPE ROPE
SLIDE LOCK PINS
FIRE EXTINGUISHER - CO2
SMOKE HOOD & ASBESTOS GLOVES
LIFE JACKET (CABIN CREW)
FIRST AID KIT (A.10)
PORTABLE OXYGEN SET (CABIN CREW)
fwd.
MEGAPHONES aft (Post Mod)
SLIDE PACK WITH INTEGRAL INFLATION
EMERGENCY PACK AND SLIDE/RAFT CANOPY
RADIO BEACON
B
SLIDE/RAFT PACK WITH REMOTE INFLATION
LIFE RAFT
RADIO BEACON
LIFE JACKET PORTABLE OXYGEN SET (CABIN CREW)
INFLATION BOTTLE
A
MEGAPHONE (GALLEY No.5 Pre-mod)
SUPPLEMENTARY EMERGENCY PACK
SMOKE GOGGLES
INFLATION BOTTLE
TORCH
EMERGENCY PACK AND SLIDE/RAFT CANOPY
LIFE JACKETS (PASSENGER) ONE UNDER EACH SEAT
MEGAPHONE (GALLEY No.4 pre-mod)
SLIDE/RAFT PACK WITH INTEGRAL INFLATION
SLIDE PACK WITH INTEGRAL INFLATION
5 LIFE JACKETS (CREW)
ESCAPE ROPE AND SMOKE GOGGLES
ASBESTOS GLOVES
EYE WASH KIT
RACK 215
FIRE EXTINGUISHER
FIRE AXE
COMPARTMENT FOR PORTABLE OXYGEN PACK
PORTABLE OXYGEN MASK
MISCELLANEOUS EQUIPMENT RACK

INTERMEDIATE AND REAR VESTIBULES



A CENTRE STOWAGES



B REAR STOWAGES

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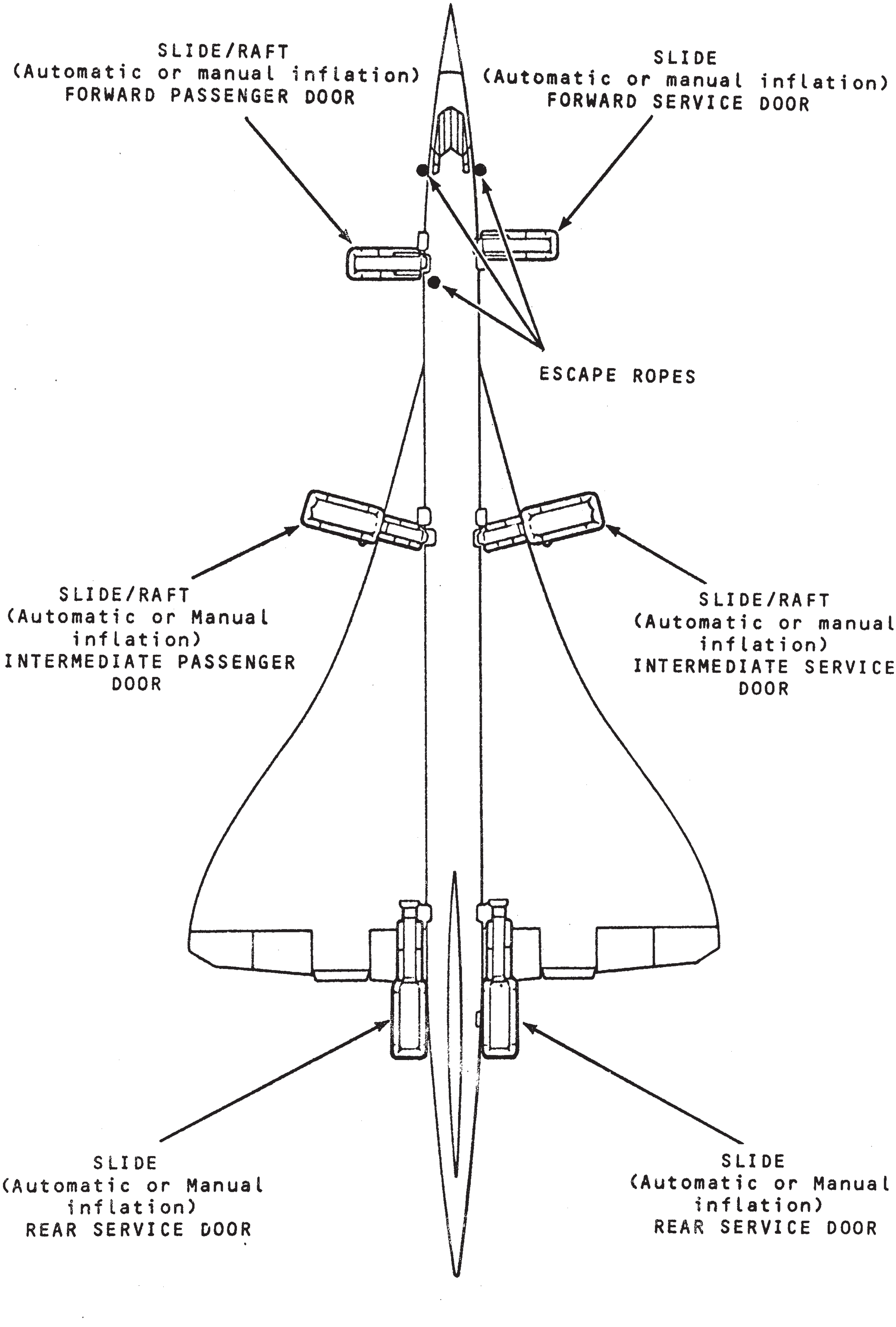
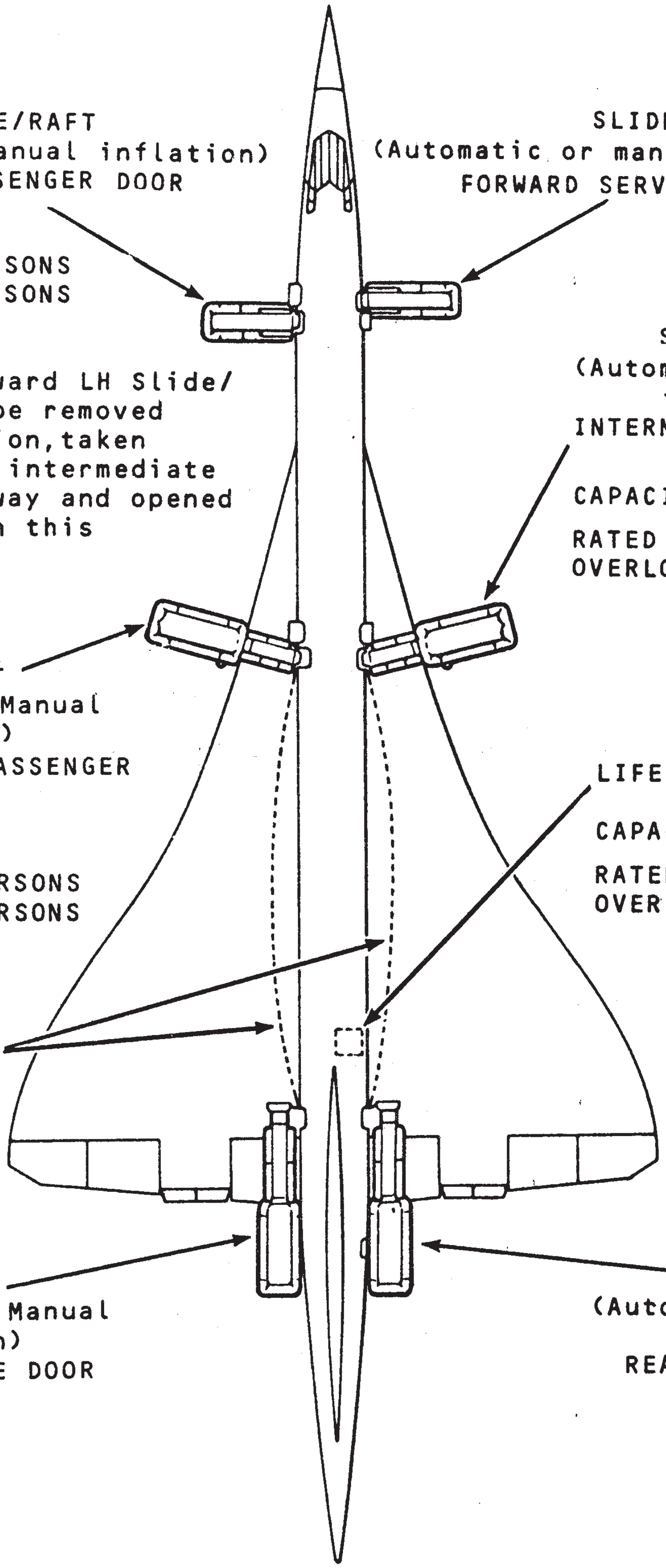
SLIDE/RAFT AND SLIDE DEPLOYMENT EMERGENCY LANDING


SLIDE/RAFT
(Automatic or manual inflation)
FORWARD PASSENGER DOOR
SLIDE
(Automatic or manual inflation)
FORWARD SERVICE DOOR
ESCAPE ROPES
SLIDE/RAFT
(Automatic or Manual inflation)
INTERMEDIATE PASSENGER DOOR
SLIDE/RAFT
(Automatic or manual inflation)
INTERMEDIATE SERVICE DOOR
SLIDE
(Automatic or Manual inflation)
REAR SERVICE DOOR
SLIDE
(Automatic or Manual inflation)
REAR SERVICE DOOR

(Unchanged)

SLIDE/RAFT AND SLIDE DEPLOYMENT DITCHING



SLIDE/RAFT
(Automatic or manual inflation)
FORWARD PASSENGER DOOR

CAPACITIES:

RATED	40 PERSONS
OVERLOAD	53 PERSONS

SLIDE
(Automatic or manual inflation)
FORWARD SERVICE DOOR

NOTE: The forward LH Slide/Raft pack can be removed from its location, taken through either intermediate passenger doorway and opened and deployed in this position.

SLIDE/RAFT
(Automatic or manual inflation)
INTERMEDIATE SERVICE DOOR

CAPACITIES:

RATED	30 PERSONS
OVERLOAD	40 PERSONS

SLIDE/RAFT
(Automatic or Manual inflation)
INTERMEDIATE PASSENGER DOOR

CAPACITIES:

RATED	38 PERSONS
OVERLOAD	51 PERSONS

LIFERAFT

CAPACITIES:

RATED	36 PERSONS
OVERLOAD	48 PERSONS

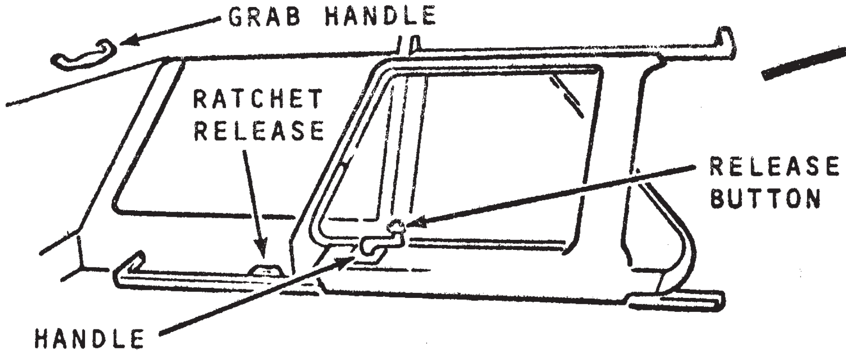
DEPLOYED DITCHING LINES

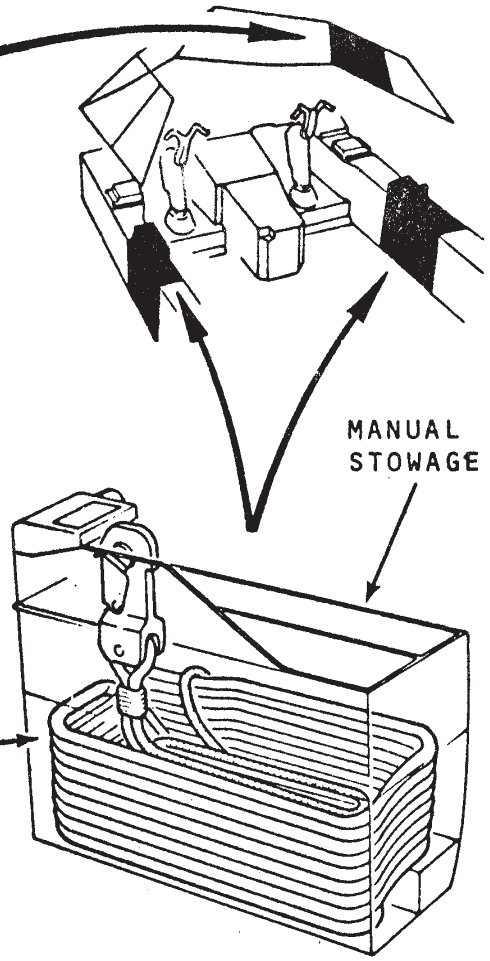
SLIDE
(Automatic or Manual inflation)
REAR SERVICE DOOR

SLIDE
(Automatic or Manual inflation)
REAR SERVICE DOOR

ALL SLIDE/RAFTS & SLIDES DISENGAGE AT DOOR SILL TO SERVE AS RAFTS AND FLOTATION AIDS

ESCAPE ROPES

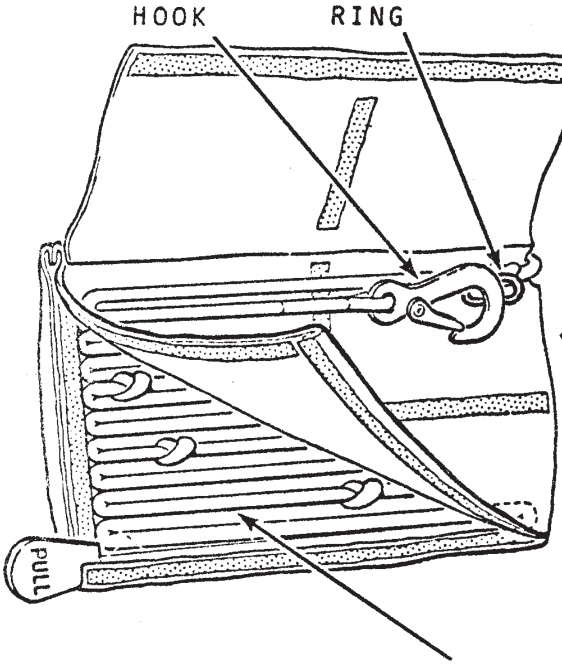


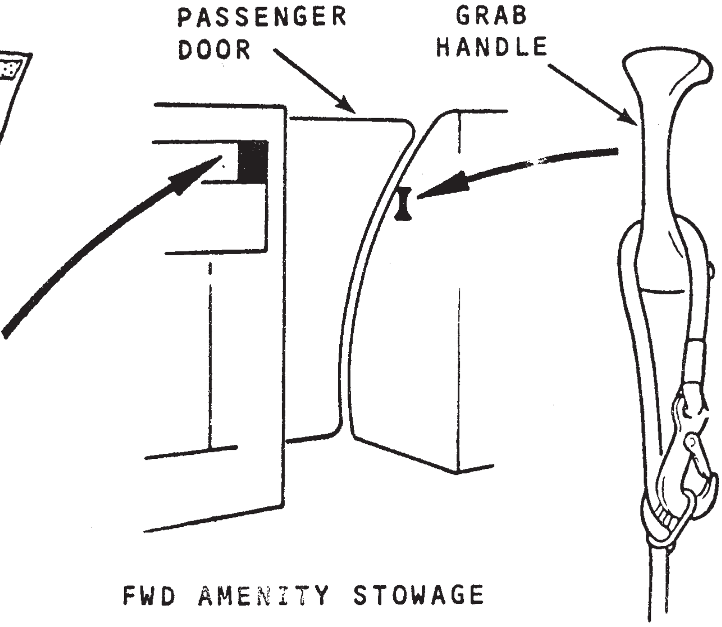


Locks sliding side window in closed position.
To open - depress release button, turn handle inboard to withdraw window inwards and slide window rearwards where it is retained in the fully open position by a pawl and ratchet.
To close - depress ratchet release, slide window forward into frame, turn handle outboard until spring loaded plunger engaged.

FLIGHT COMPARTMENT ESCAPE ROPES (2)

Clasp hook to pilot's grab handle and deploy white rope overboard through sliding side window. Red section remains shackled to aircraft structure.



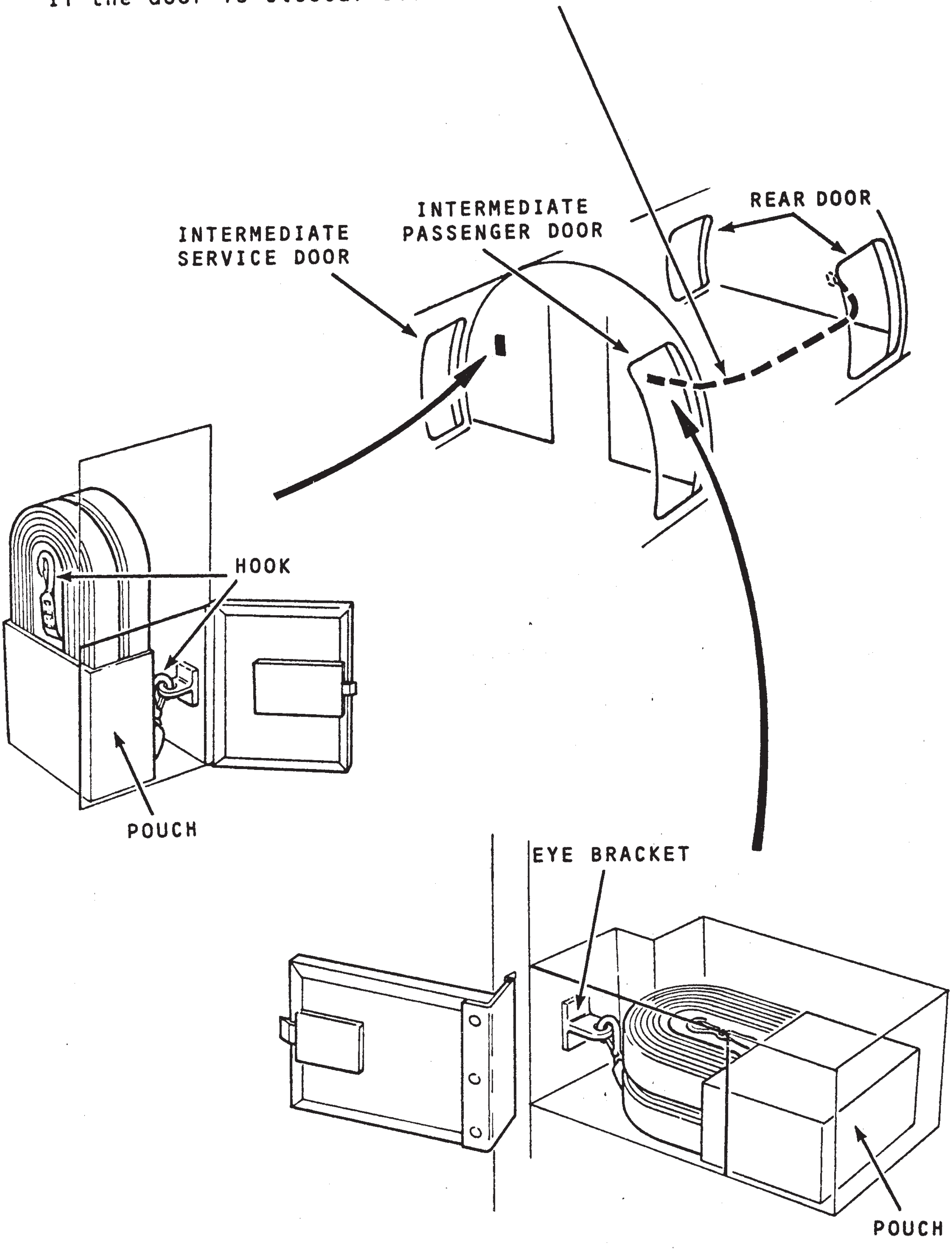


FORWARD VESTIBULE ESCAPE ROPE

Pass hook through grab handle, clip into ring and deploy rope overboard. This rope can be used at either the Forward passenger or Forward service doors.

DITCHING LINES

Remove line and pouch from its stowage, ensuring that one end of the line remains attached. Take the free end of the line along the wing around the rear door and clip it to the bracket provided on the hinge side of the doorway. If the door is closed, secure the line to the outer handle.



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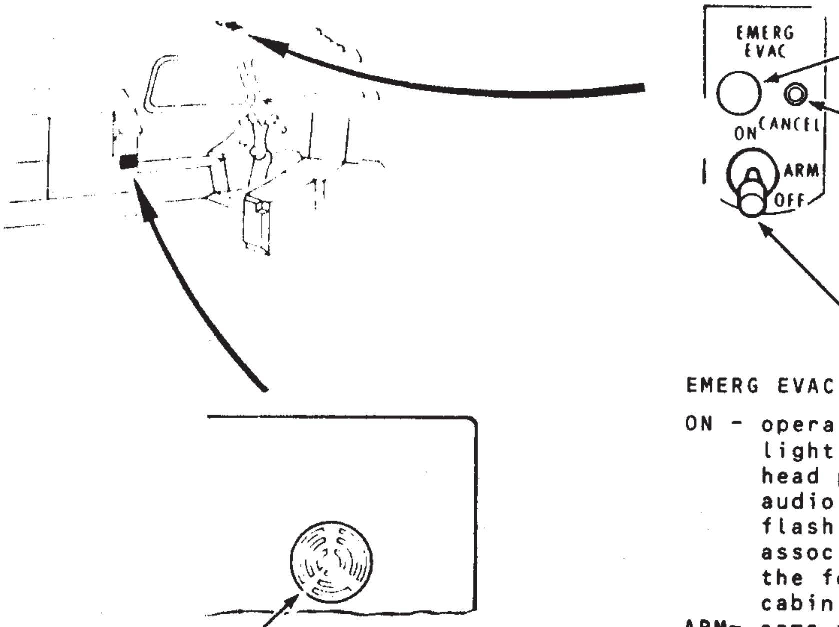
EMERGENCY EVACUATION ALERT SYSTEM



LIGHT (Red)

CANCEL PUSH BUTTON

Pressed - cancels the flight deck audio (bleeper).

EMERG EVAC SELECTOR

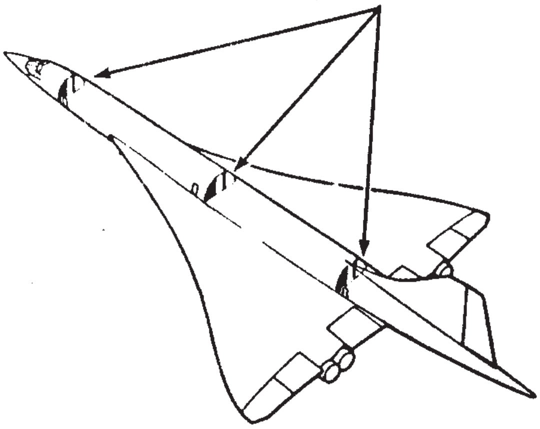
ON - operates an EMERG EVAC flashing light (red) on the rear overhead panel and a flight deck audio (bleeper) also an EVAC flashing light (red) and an associated audio (bleeper) on the forward, centre and rear cabin staff panels.

ARM- arms the EVACUATION ALERT ON/OFF switch on the forward cabin staff panel.

OFF- breaks power supply to the main emergency evacuation alert system.

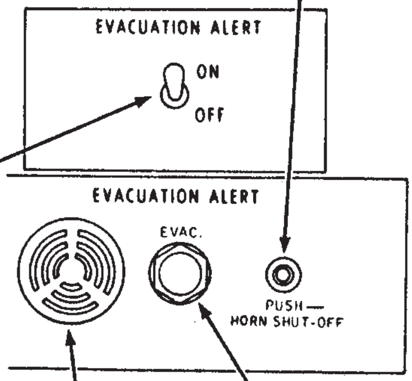
EVAC HORN
(Bleeper 2 x sec)

VESTIBULES



PUSH - HORN SHUT-OFF

Push button on the forward, centre and rear cabin staff panels cancels the associated audio (bleeper).



SYSTEM CONTROL SWITCH
(Forward vestibule only)

With EMERG EVAC selector on Flight deck rear o/head panel at OFF:
If EVACUATION ALERT ON/OFF switch is set to ON the EMERG EVAC light (red) on rear overhead panel will flash.
With EMERG EVAC selector at ARM:
EVACUATION ALERT switch at ON operates EMERG EVAC flashing light (red) on the rear overhead panel and a flight deck audio (bleeper), also an EVAC flashing light (red) and associated audio (bleeper) on the forward, centre and rear cabin staff panels.

EVAC HORN
(Bleeper 2 x sec)

LIGHT (Red)

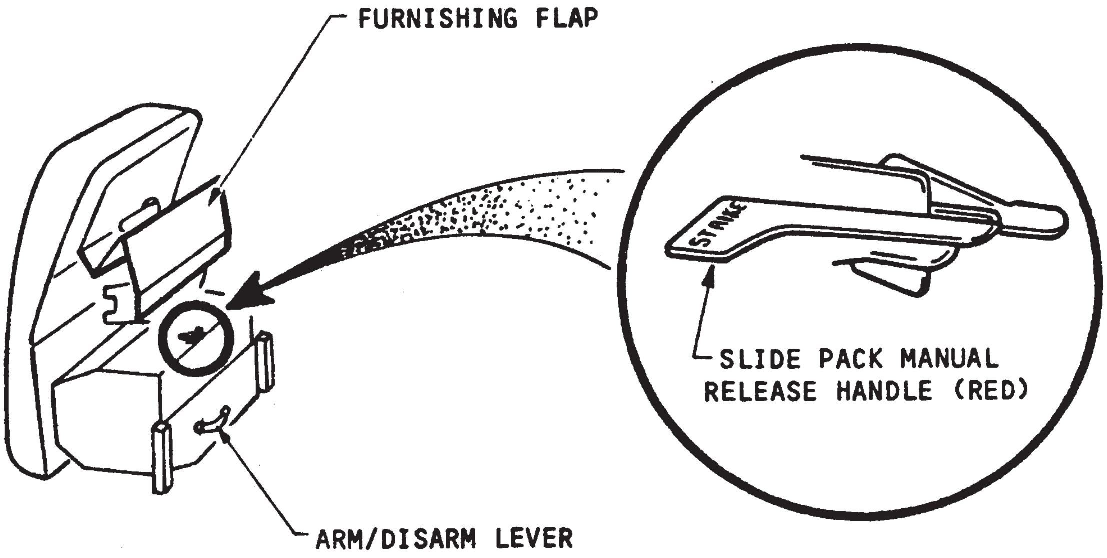
(Unchanged)

SLIDE RAFT AND SLIDE MANUAL RELEASE

If pack does not drop automatically when opening armed door, do not attempt to force the door fully open:-

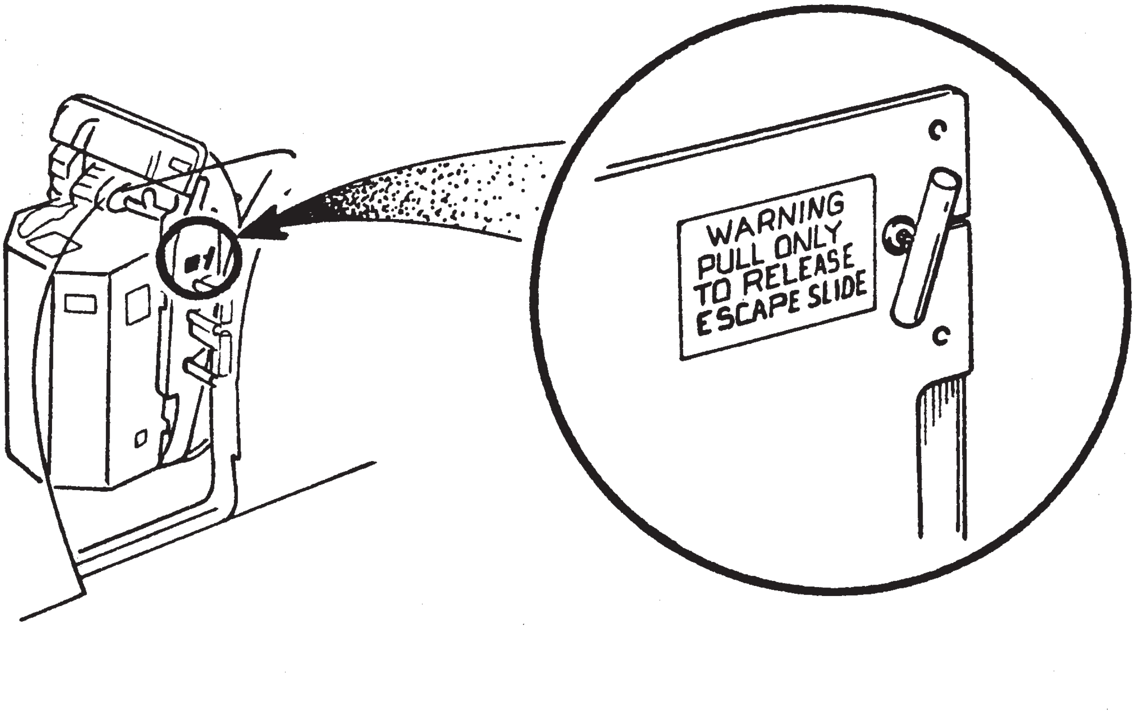
FRONT AND CENTRE DOORS

-Lift hinged furnishing flap on door if necessary
-Strike pack release handle downwards to drop pack from door
-Continue to open door into the fully open position.



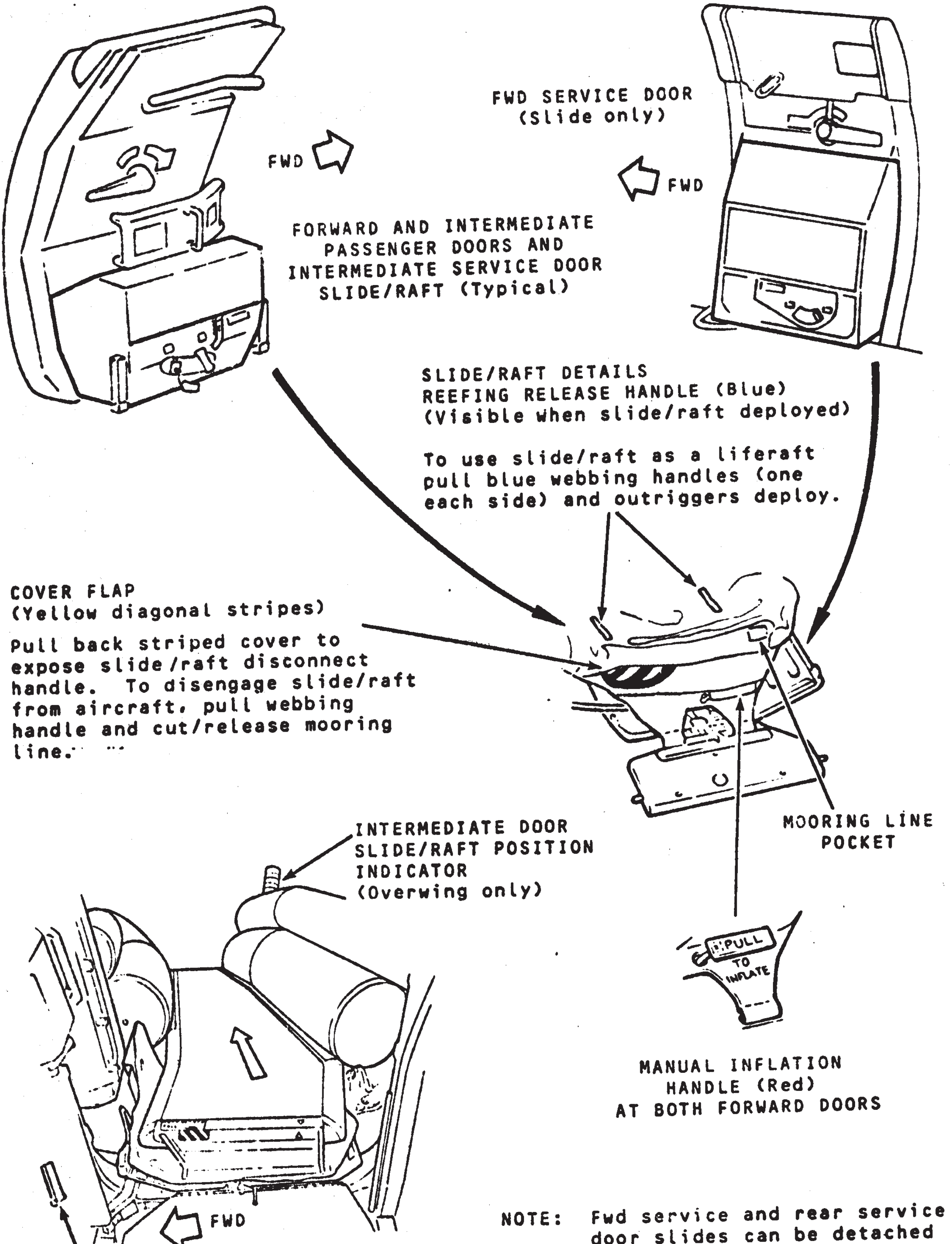
REAR DOORS

-Pull the red 'T' handle on the forward flank of the door to drop pack from door
-Continue to open door into its normal open position.



(Completely Revised)

SLIDE/RAFT AND SLIDE DISCONNECTION AND POSITION INDICATOR FORWARD AND INTERMEDIATE DOOR



FWD SERVICE DOOR
(Slide only)

FORWARD AND INTERMEDIATE PASSENGER DOORS AND INTERMEDIATE SERVICE DOOR SLIDE/RAFT (Typical)

SLIDE/RAFT DETAILS
REEFING RELEASE HANDLE (Blue)
(Visible when slide/raft deployed)

To use slide/raft as a liferaft pull blue webbing handles (one each side) and outriggers deploy.

COVER FLAP
(Yellow diagonal stripes)

Pull back striped cover to expose slide/raft disconnect handle. To disengage slide/raft from aircraft, pull webbing handle and cut/release mooring line.

MOORING LINE POCKET

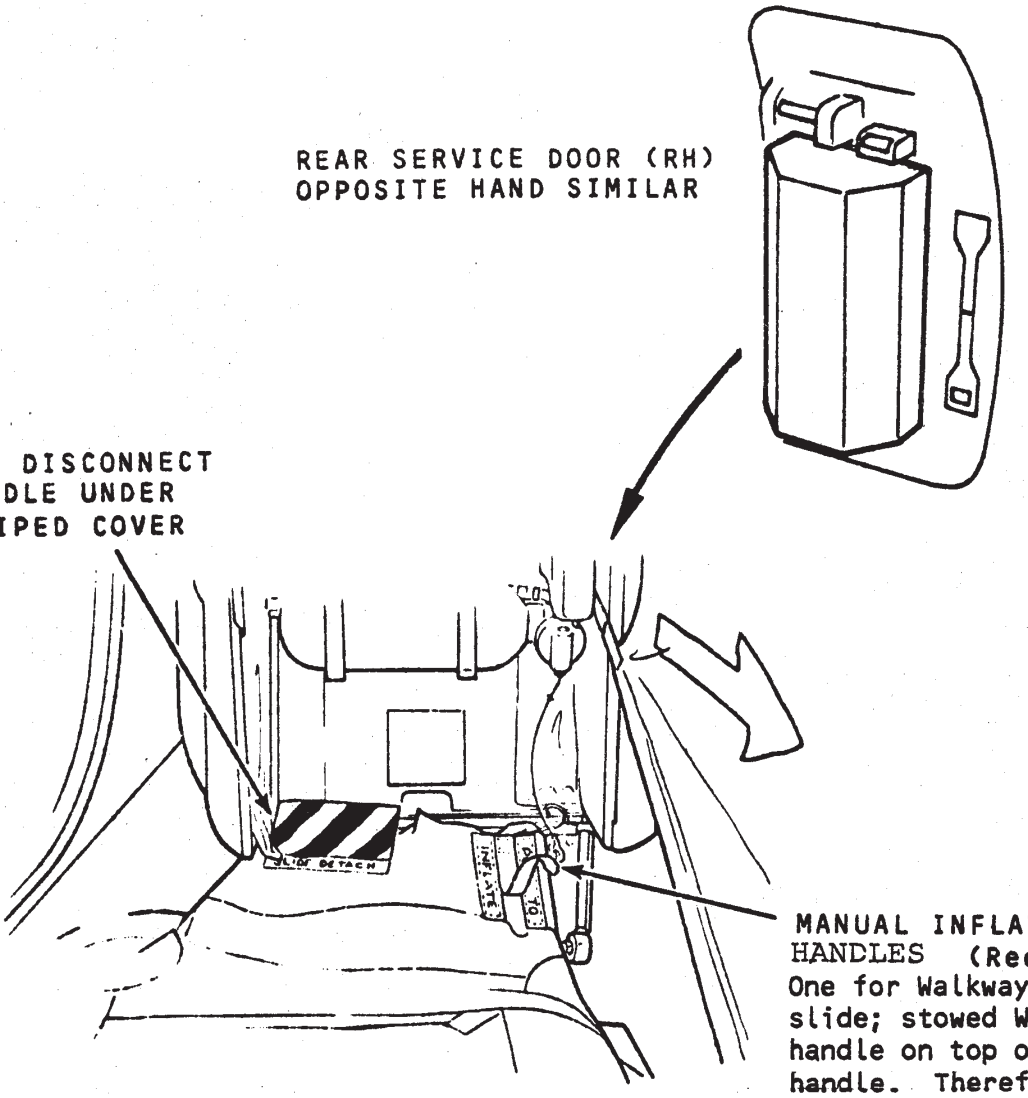
INTERMEDIATE DOOR SLIDE/RAFT POSITION INDICATOR
(Overwing only)

MANUAL INFLATION HANDLE (Red)
AT BOTH FORWARD DOORS

MANUAL INFLATION HANDLE (Red) ON DOOR SURROUND AT BOTH INTERMEDIATE DOORS.

NOTE: Fwd service and rear service door slides can be detached from aircraft and used as additional flotation aids in the event of ditching.

SLIDE/RAFT AND SLIDE DISCONNECTION AND POSITION INDICATOR REAR DOOR



REAR SERVICE DOOR (RH)
OPPOSITE HAND SIMILAR

SLIDE DISCONNECT
HANDLE UNDER
STRIPED COVER

MANUAL INFLATION
HANDLES (Red)
One for Walkway, one for slide; stowed Walkway handle on top of slide handle. Therefore only sequential operation possible, Walkway first then slide.

(Deletion)

MOVING FORWARD SLIDE/RAFT TO INTERMEDIATE DOOR EXIT

AFTER DITCHING

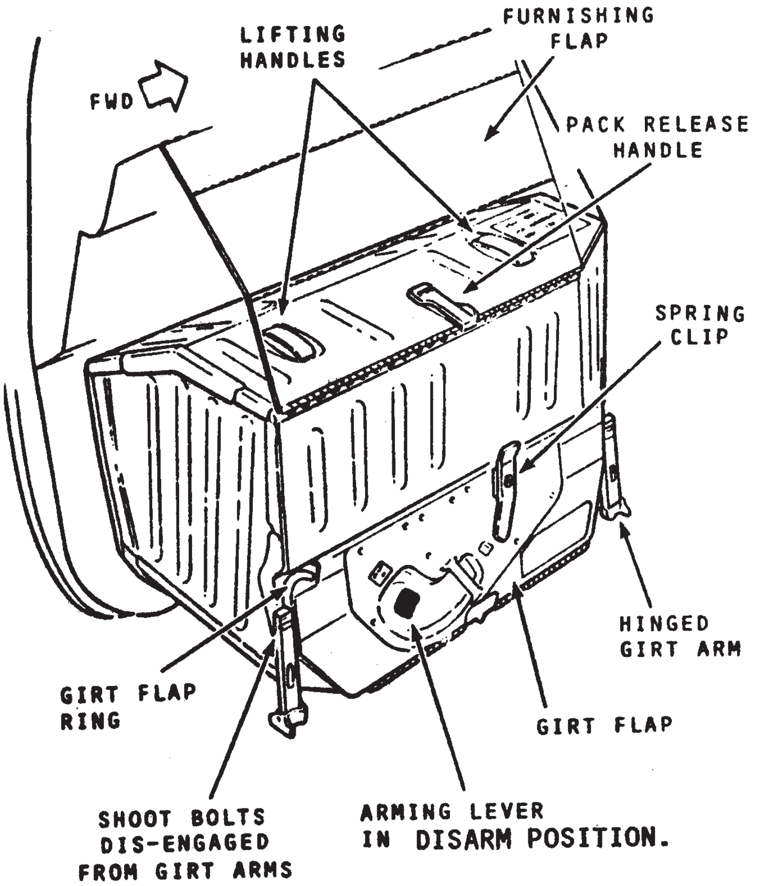
When forward passenger door cannot be opened, the escape slide/raft container pack can be removed from the door and taken to an intermediate door exit. The slide/raft mounted on intermediate door must be fully deployed and disconnected from aircraft, but mooring line need not be removed. Remove attachment hook and strap from pocket in liner of used container and lay out in readiness for attaching to other pack.

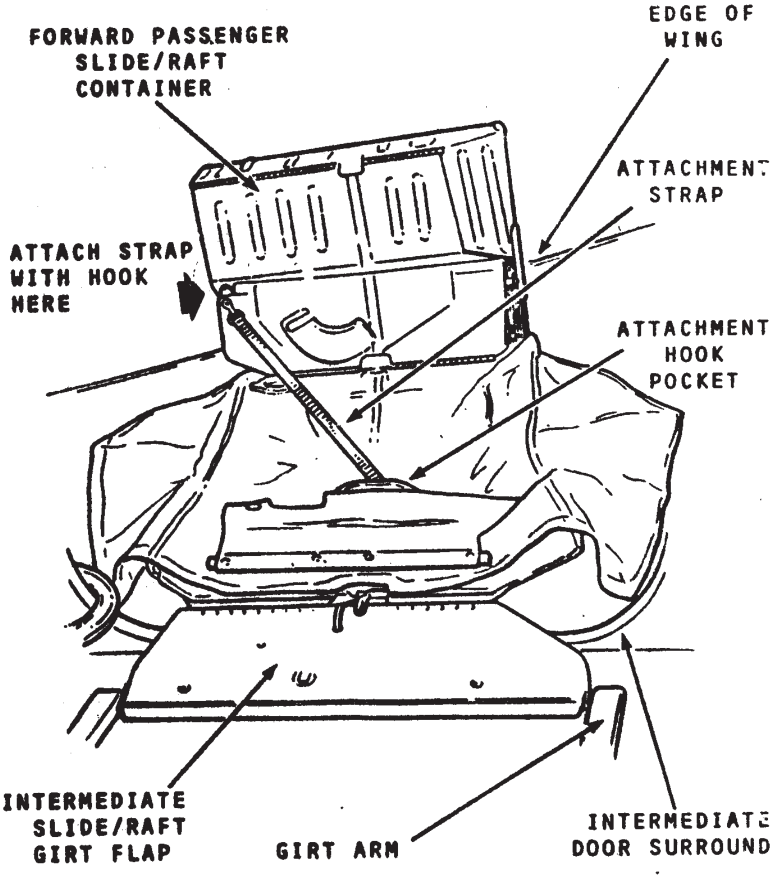
To remove slide/raft pack from forward door and move to another door:

Set arming lever to DISARM.
Lift door trim covering container, and strike trip lever downward.
Container will fall free from carriage.
Use lifting handles to carry pack to another door.

CAUTION: TO PREVENT SLIDE/RAFT FOULING DOOR DURING INFLATION, PLACE CONTAINER OUTSIDE OF DOOR SO THAT HOOK ATTACHMENT STRAP IS FULLY EXTENDED BEFORE SECURING HOOK TO GIRT FLAP.

Secure attachment hook to girt flap ring on left side of flap, rotate spring clip through 90° then set arming lever to ARM, push container across wing and unroll slide/raft to expose manual operating handle and mooring line hook. Attach mooring line to aircraft structure, pull red operating handle to inflate slide/raft. Pull blue webbing handles marked PULL FOR RAFT to deploy raft. Pull handle marked RAFT DETACH. Raft is now ready for boarding. When ready to leave vicinity of aircraft pull and cut mooring line.



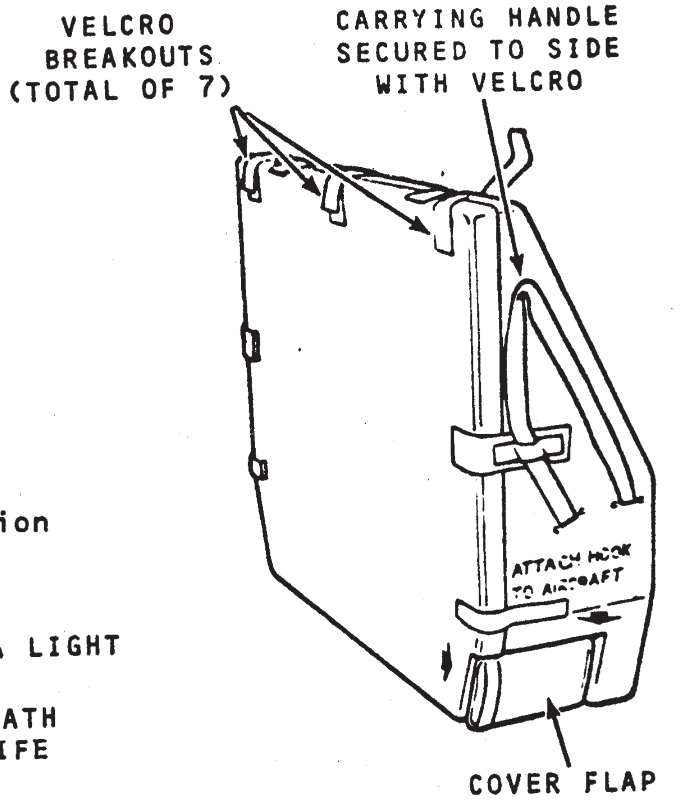

FORWARD PASSENGER SLIDE/RAFT CONTAINER
EDGE OF WING
ATTACHMENT STRAP
ATTACH STRAP WITH HOOK HERE
ATTACHMENT HOOK POCKET
INTERMEDIATE SLIDE/RAFT GIRT FLAP
GIRT ARM
INTERMEDIATE DOOR SURROUND

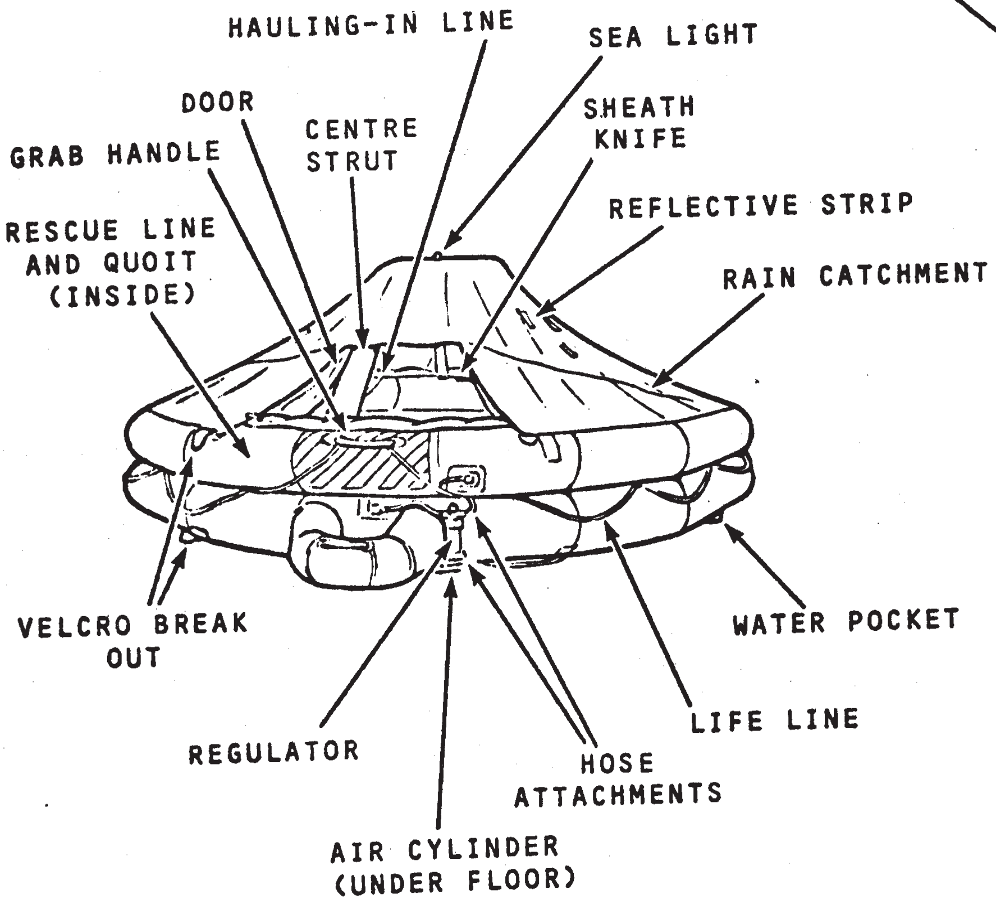
LIFERAFT TYPE 36UA MK 1

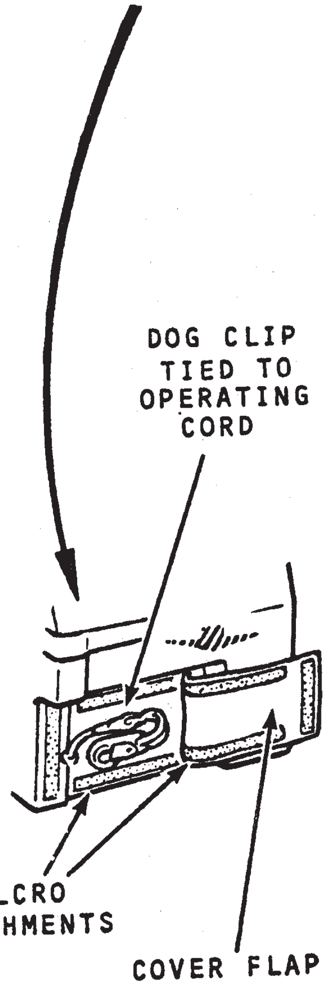
36 PERSON LIFERAFT

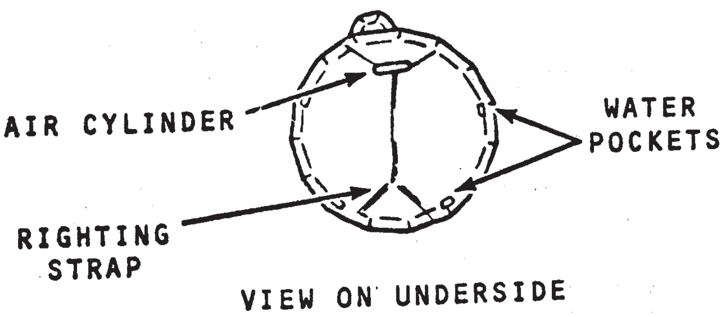
Stowed rear of rear cabin on RH side.
To use:
Remove from stowage and carry to nearest exit.
Peel open cover flap and attach operating cord to strong point using the dog clip.
Open aircraft door and throw container into the sea.
Pull operating cord sharply.
Liferaft will inflate and deploy.

NOTE: The operating cord is used as a mooring line to position and secure the liferaft


VELCRO BREAKOUTS (TOTAL OF 7)
CARRYING HANDLE SECURED TO SIDE WITH VELCRO
ATTACH HOOK TO AIRCRAFT
COVER FLAP







VIEW ON UNDERSIDE

Chapter 8

FIRE PROTECTION

FIRE PROTECTION

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Controls and Indicators

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Engine Overheat Test 08.03.04
Fire and Nacelle Overheat Test 08.03.05
Fire and Flame Sensors 08.03.06
Engine Warning Lights 08.03.07

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GENERAL

The fire protection system provides the means to detect and extinguish a fire and/or overheat condition in the engine nacelles, a smoke detection system in the air generation ducts, and cabin and freight hold areas. Aural and visual indications are provided to alert the flight crew to fire, overheat or smoke conditions.

ENGINE BAY FIRE DETECTION

A conventional engine bay fire detection system, consisting of dual sensing loops, is so controlled that normally both loops must detect a fire condition before the warnings are triggered. The control enables a failed loop to be isolated and its operation to continue with the remaining loop.

ENGINE OVERHEAT DETECTION

An engine overheat detection system monitors specific points in the engine for high temperature.

NACELLE OVERHEAT DETECTION

A nacelle overheat detection system consisting of simple temperature sensing elements connected in series to form loops on the engine nacelle doors,is provided to cover areas where air or gas leaks may impinge.

WING OVERHEAT DETECTION

A wing overheat detection system,consisting of thermal switches, is provided in the rear equipment bay above each engine to sense any leakage of hot air from the air conditioning system.

TORCHING FLAME DETECTION

An engine bay flame detection system monitors the combustion chamber area of the engine for flame breakout. The system consists of dual detector loops so controlled that normally both loops must detect a flame breakout before the warnings are triggered. The control enables a failed loop to be isolated and operation to continue with the remaining loop.

ENGINE FIRE EXTINGUISHING

Four fire extinguisher bottles,one in each engine dry bay, are electrically discharged from the flight deck. Each extinguisher bottle has two firing heads and is capable of discharging into its own or the adjacent engine bay. When an extinguisher is fired, the contents of the bottle are discharged through nozzles around the engine and act to close a fire valve across the cooling air flow to the air conditioning primary and secondary heat exchangers of the engine.

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FIRE FLAPS

A fire flaps system seals off the engine bay to starve any fire of oxygen. Fire flaps is the term used to identify the secondary air doors and engine bay vent in the engine fire zone. They are shut when the engine shut down handle is pulled.

FUEL TANK VENT IGNITION SUPPRESSION

A fuel tank vent ignition suppression system uses a flame detector that automatically triggers the discharge of an extinguishant into the vent pipe between the detector and the fuel tanks. This ensures that any external ignition of the vented fuel vapour cannot propagate back to the fuel tanks.

SMOKE DETECTION

Smoke detection systems are installed in the air generation ducts and the cabin and freight hold areas.

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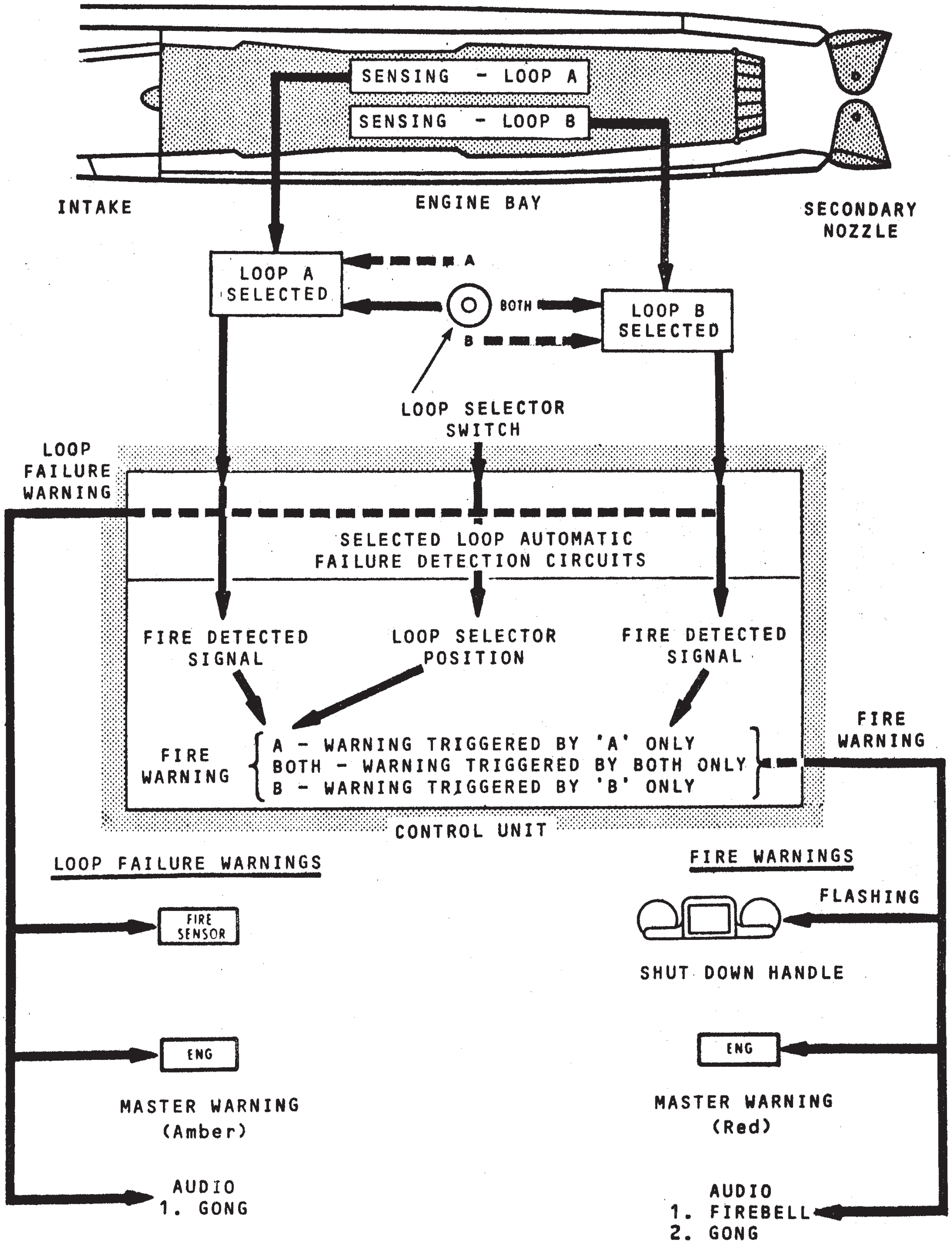
ENGINE BAY FIRE DETECTION



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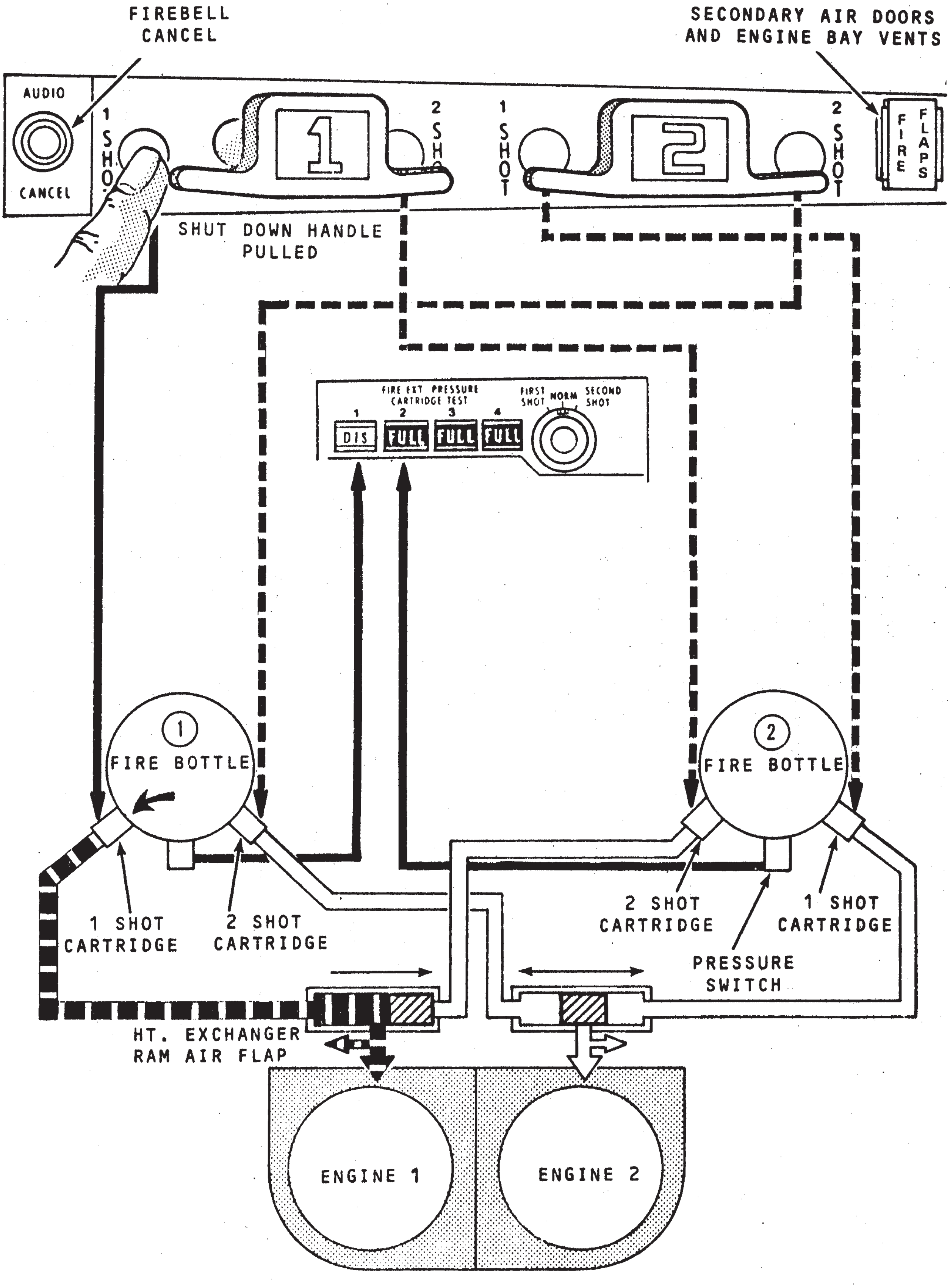
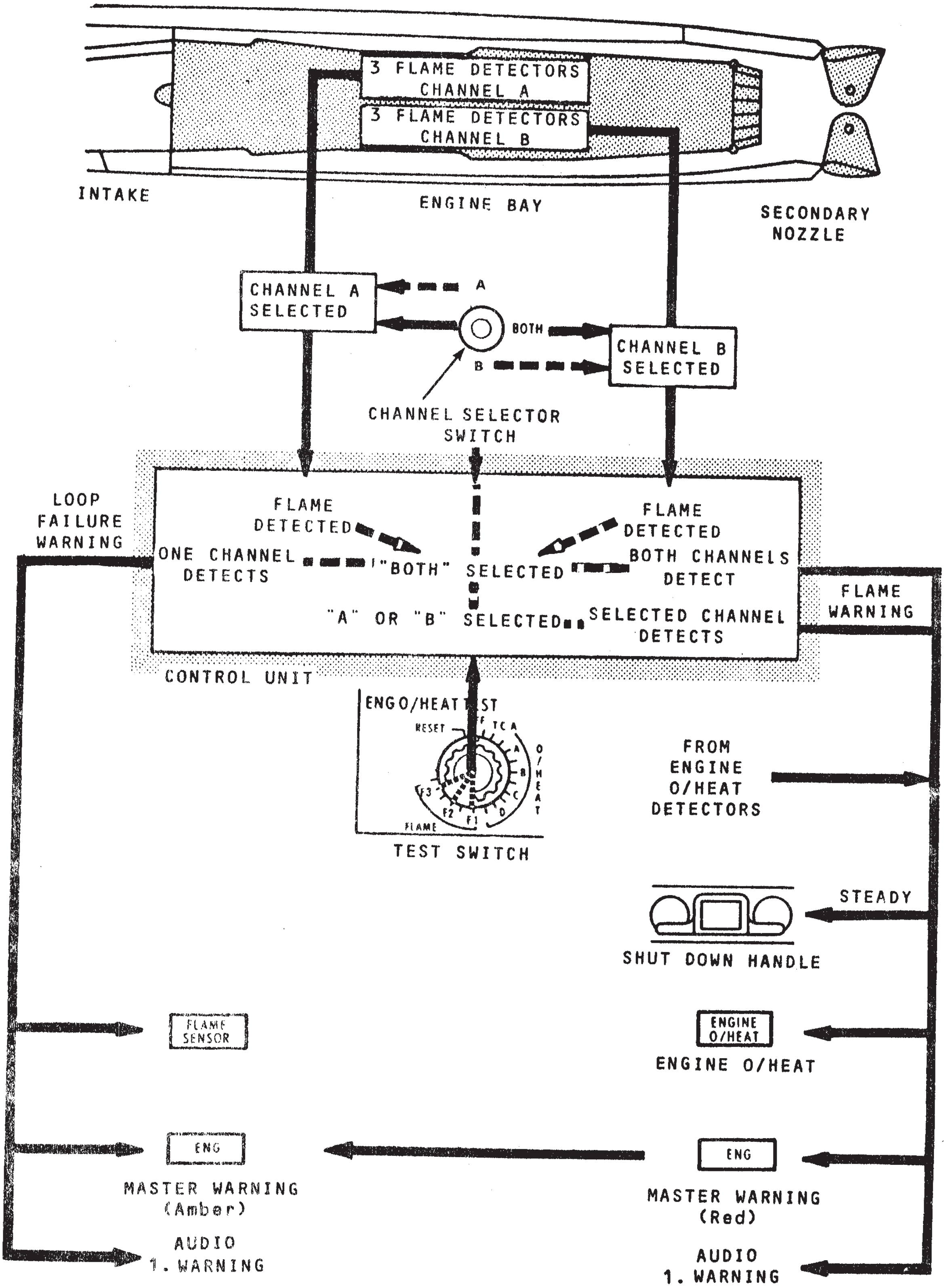
ENGINE BAY FIRE PROTECTION



LEFT NACELLE SHOWN.
RIGHT NACELLE SIMILAR.

ENGINE BAY TORCHING FLAME DETECTION



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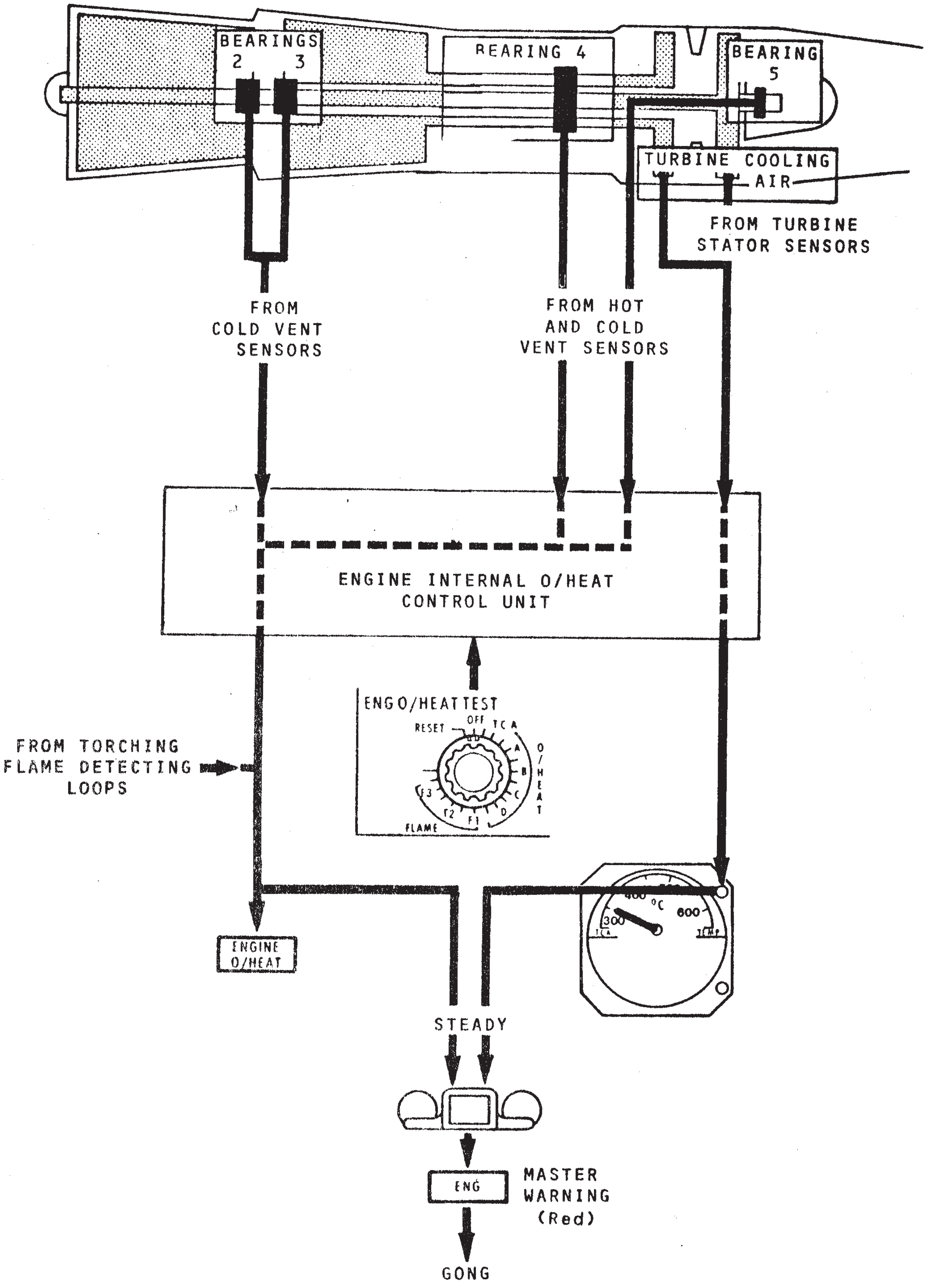
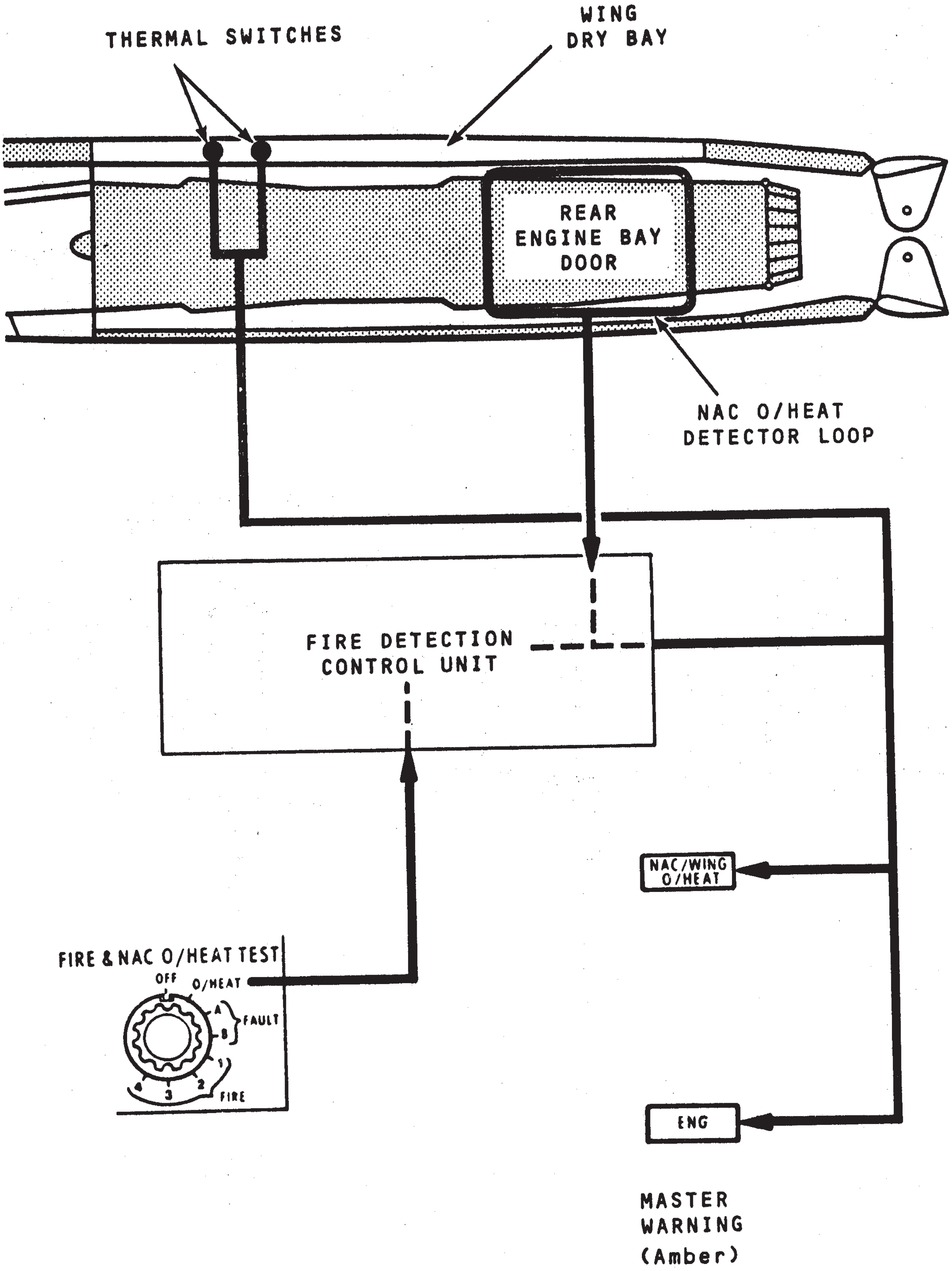
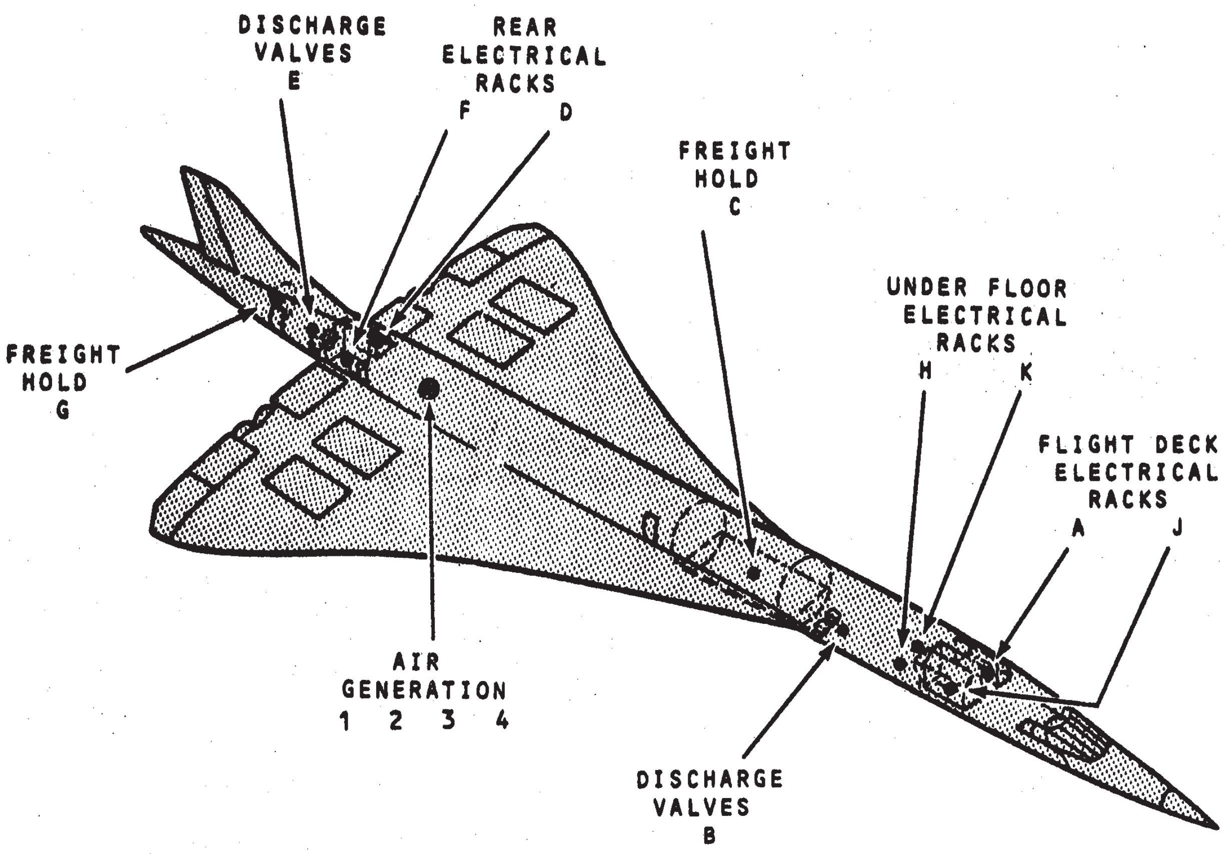
ENGINE OVERHEAT

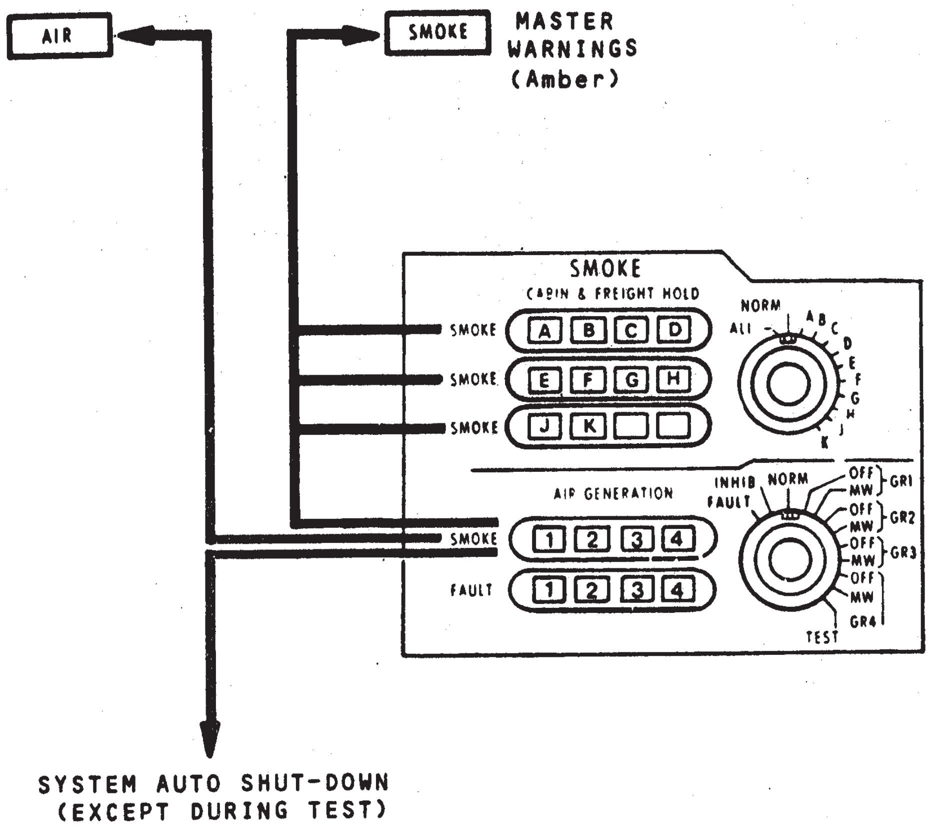


WING/NACELLE OVERHEAT



SMOKE DETECTION


DISCHARGE VALVES E
REAR ELECTRICAL RACKS F D
FREIGHT HOLD C
UNDER FLOOR ELECTRICAL RACKS H K
FLIGHT DECK ELECTRICAL RACKS A J
FREIGHT HOLD G
AIR GENERATION 1 2 3 4
DISCHARGE VALVES B



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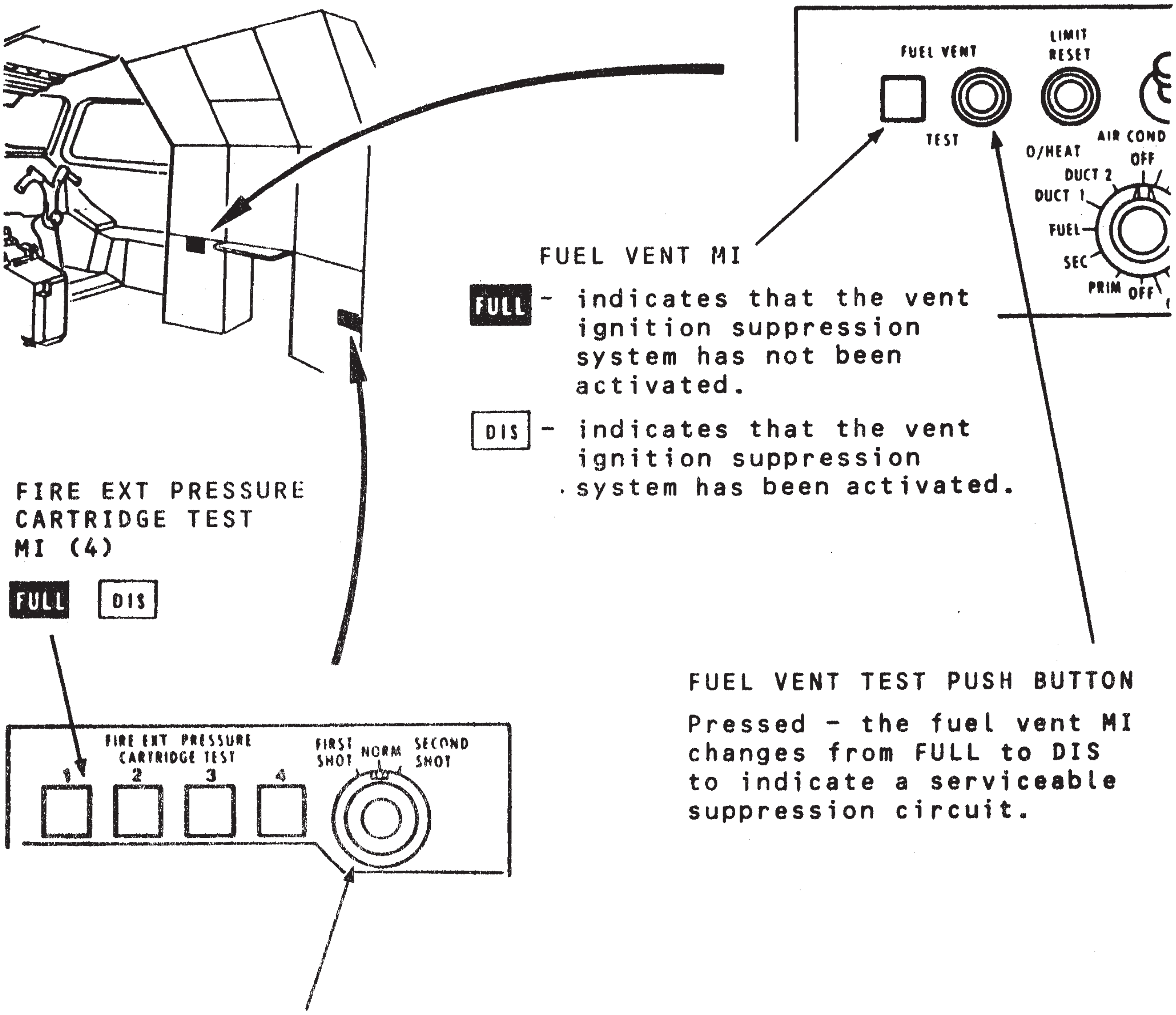
ENGINE BAY FIRE EXTINGUISHING & FUEL VENT



FUEL VENT MI

FULL - indicates that the vent ignition suppression system has not been activated.

DIS - indicates that the vent ignition suppression system has been activated.

FIRE EXT PRESSURE CARTRIDGE TEST MI (4)

FULL DIS

FUEL VENT TEST PUSH BUTTON

Pressed - the fuel vent MI changes from FULL to DIS to indicate a serviceable suppression circuit.

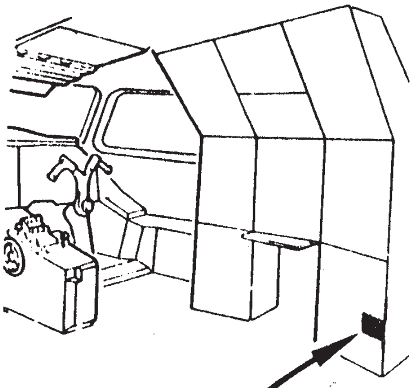
FIRE EXT PRESSURE CARTRIDGE TEST SELECTOR

NORM - checks the pressure of the fire extinguisher bottle. There is one bottle per engine. Correct charge pressure of the bottle is indicated when its relevant magnetic indicator reads FULL.
A discharged or low pressure bottle is indicated by the same magnetic indicator reading DIS.

FIRST SHOT - checks the continuity of the first shot electrical firing circuit to the first shot cartridge of the dual operating head of the fire extinguisher bottle.
Satisfactory check operation is shown by the magnetic indicator reading DIS.

SECOND SHOT - checks the continuity of the second shot electrical firing circuit to the second shot cartridge of the dual operating head of the fire extinguisher bottle.
Satisfactory check operation is shown by the magnetic indicator reading DIS.

SMOKE DETECTION AND AIR GENERATION

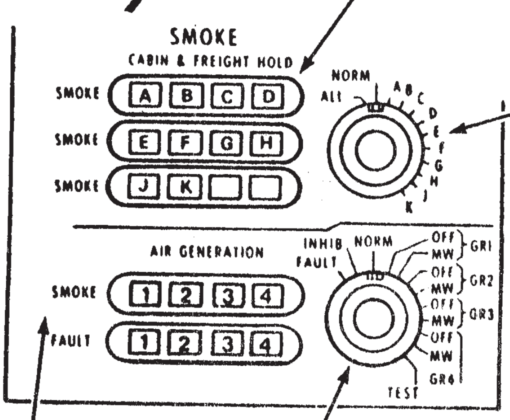


SMOKE, CABIN AND FREIGHT HOLD, LIGHTS (Amber) (10)

On - indicates that smoke is detected in an area as follows:

A - Left forward electrical racking.
B - Forward cabin pressurization discharge valves.
C - Forward lower freight hold.
D - Left rear electrical racking.
E - Rear cabin pressurization discharge valves.
F - Right rear electrical racking.
G - Upper rear freight hold.
H - Right underfloor electrical racking.
J - Right forward electrical racking.
K - Left underfloor electrical racking.

Accompanied by MWS SMOKE light (amber) and audio (gong).



CABIN AND FREIGHT HOLD ROTARY SELECTOR

Used to test the smoke detection system.

ALL - tests the continuity of the electrical circuits of the 10 smoke detectors in the cabin and freight hold simultaneously. The areas of surveillance are identified by a letter.
NORM - the detection circuits are armed and the test circuits are off.
A to K - check individual smoke detectors.

AIR GENERATION ROTARY SELECTOR

FAULT - tests continuity of AIR GENERATION smoke detection circuits.
INHIB - overrides the auto shut down of AIR GENERATION group(s) by associated AIR GENERATION smoke detection system(s).
NORM - connects the AIR GENERATION smoke detection system to the MWS.
GR1 OFF - cancels the SMOKE 1 light and the MWS SMOKE light.
GR1 MW - tests the No 1 AIR GENERATION smoke detection system's connection with the MWS.

GR2 OFF
MW
GR3 OFF } as GR1 OFF
MW MW
GR4 OFF
MW

TEST - tests the continuity of the detectors and circuits of the four AIR GENERATION smoke detection systems simultaneously.
NOTE: TEST must be selected before the individual group tests will operate.

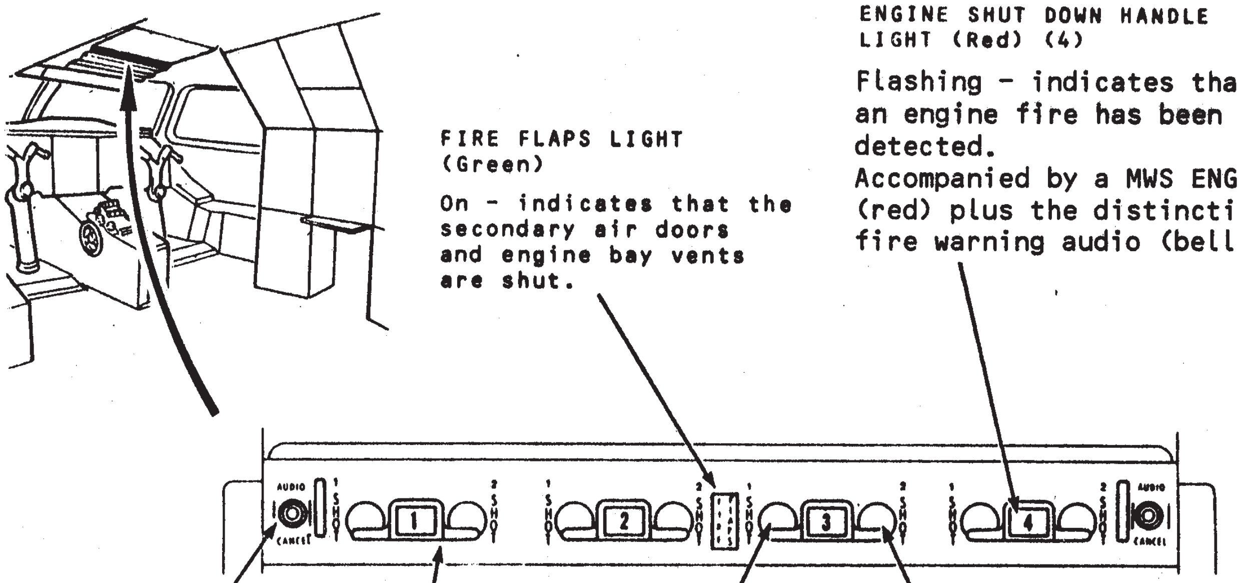
SMOKE 1 2 3 4 LIGHTS (Amber)

On - indicates smoke detected in associated AIR GENERATION group, accompanied by MWS SMOKE (amber) and MWS AIR (amber)

FAULT 1 2 3 4 LIGHTS (Yellow)

On - indicates a fault in the smoke detection system of the associated AIR GENERATION group.

ENGINE SHUT DOWN



FIRE FLAPS LIGHT (Green)

On - indicates that the secondary air doors and engine bay vents are shut.

ENGINE SHUT DOWN HANDLE LIGHT (Red) (4)

Flashing - indicates that an engine fire has been detected.
Accompanied by a MWS ENG (red) plus the distinctive fire warning audio (bell).

AUDIO CANCEL PUSH BUTTON (2)

Pressing - cancels the warning distinctive audio (bell).
Refer also to Master Warning.

1 SHOT PUSH BUTTON (4)

Pressing - discharges the fire extinguisher bottle of the associated engine and cancels the FIRE FLAPS light.

2 SHOT PUSH BUTTON (4)

Pressing - discharges the fire extinguisher bottle of the adjacent engine into the affected engine bay.

ENGINE SHUT DOWN HANDLE (4)

Pulling the engine shut down handle when its light (red) is flashing, dims the light and:

Shuts the HP VALVE
Switches the HP VALVE switch light (white) on.
Shuts the LP VALVE.
Shuts the HYDRAULIC SHUT OFF VALVE(s)
Shuts the REHEAT fuel shut off valve.
Shuts the air BLEED VALVE.
Shuts the air CROSS BLEED valves.
Shuts the cabin inlet safety valve.
Shuts the SECONDARY AIR DOORS and engine bay vents, thus causing the FIRE FLAPS light (green) to come on.
Onloads the standby (yellow) hydraulic system.
Opens the ENGINE RECIRCULATION VALVE.
Inhibits the engine igniters.
Inhibits the T_1 engine probe heater, thus causing the T_1 light (yellow) to come on.

NOTE: The triangle (orange) next to the following MIs:
HP VALVE
LP VALVE
Hydraulic SHUT OFF VALVE
Air BLEED VALVE
Air CROSS BLEED
SECONDARY AIR DOORS
indicates that the associated valves and doors are shut by pulling the engine shut down handle.

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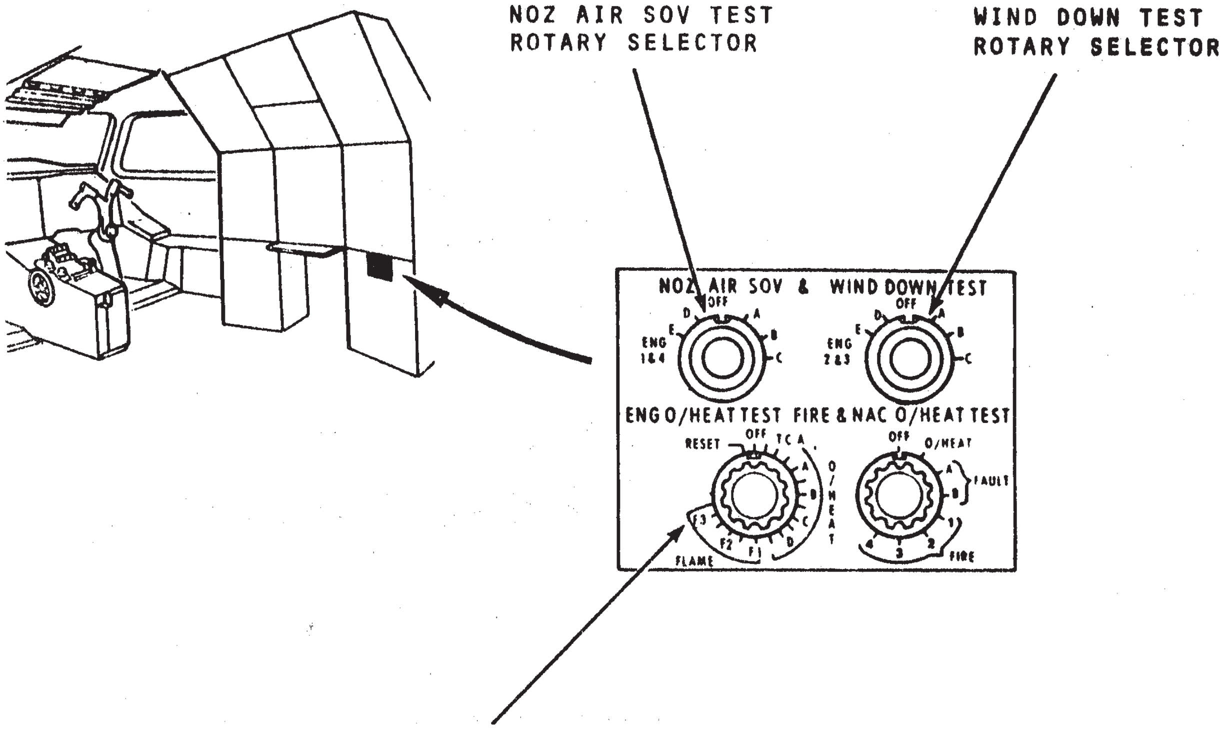
(Unchanged)

ENGINE OVERHEAT TEST



ENGINE O/HEAT TEST ROTARY SELECTOR

RESET - then OFF, cancels the warning light(s)

TCA - the turbine cooling air high temperature warning system is being tested by a simulated overheat condition.

O/HEAT A - the high temperature warning of the cooling air for engines Nos.2 and 3 bearings is being tested by a simulated overheat condition.

O/HEAT B - the high temperature warning of the cooling air for the engines' Nos.4 and 5 bearings is being tested by a simulated overheat condition.

O/HEAT C - the high temperature warning of the engines' high pressure compression seal vent is being tested by a simulated overheat condition.

O/HEAT D - the high temperature warning of the engines' turbine bearing seal vent is being tested by a simulated overheat condition.

FLAME F$_1$ - providing the FLAME SENSOR selector is at BOTH, both detectors of the twin detector unit of each engine's flame breakout. detection system, positioned on the nacelle centre wall, are being tested by simulating a flame at the detectors.

FLAME F$_2$ - providing the FLAME SENSOR selector is at BOTH, both detectors of the twin detector unit of the engine's flame breakout detection system, positioned on each engine bay rear door, are being tested by simulating a flame at the detectors.

FLAME F$_3$ - providing the FLAME SENSOR selector is at BOTH, both detectors of the twin detector unit of each engine's flame breakout. detection system, positioned on the engine bearer, are being tested by simulating a flame at the detectors.

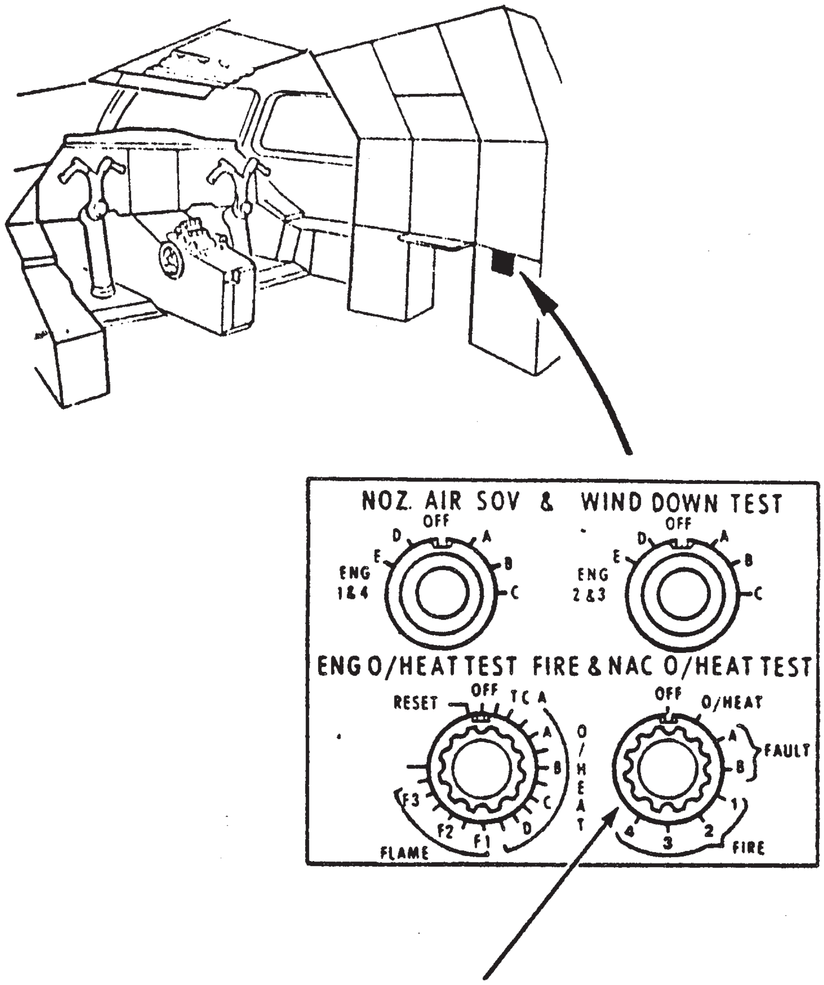
(Deletion)

The unmarked positions (8) between TCA and RESET are reset positions.

NOTE: (1) The selector must remain at the reset position between F$_1$, F$_2$, F$_3$ and RESET for 5 secs to enable the reset to be effective.

(2) All four engines are tested simultaneously.

FIRE AND NACELLE OVERHEAT TEST



FIRE & NAC O/HEAT TEST ROTARY SELECTOR

O/HEAT - tests the nacelle overheat detection systems by simulating an overheat condition.

FAULT A - tests the engine fire detection system's loop A amplifiers fault detection circuit.

FAULT B - tests the engine fire detection system's loop B amplifiers fault detection circuit.

FIRE 1 - providing the FIRE SENSOR selector is at BOTH, the electrical continuity of both the No.1 engine fire detection firewire loops is tested by simulating a warning to operate the detection relays.

FIRE 2 - providing the FIRE SENSOR selector is at BOTH, the electrical continuity of both the No.2 engine fire detection firewire loops is tested by simulating a warning to operate the detection relays.

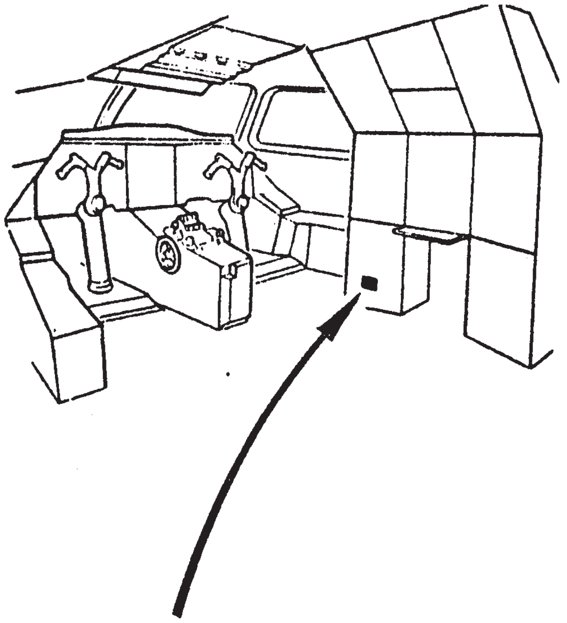
FIRE 3 - providing the FIRE SENSOR selector is at BOTH, the electrical continuity of both the No.3 engine fire detection firewire loops is tested by simulating a warning to operate the detection relays.

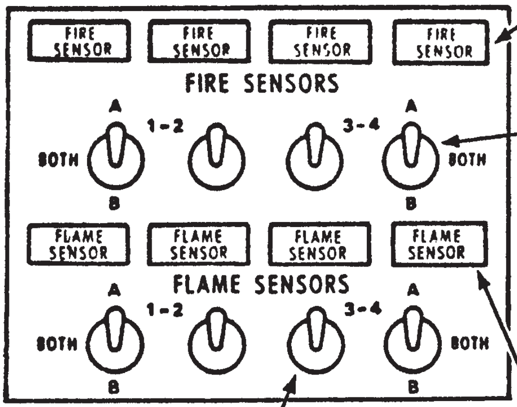
FIRE 4 - providing the FIRE SENSOR selector is at BOTH, the electrical continuity of both the No.4 engine fire detection firewire loops is tested by simulating a warning to operate the detection relays.

(Deletion)

NOTE: All four engines are tested simultaneously during the O/HEAT, FAULT A and FAULT B tests.

FIRE AND FLAME SENSORS





FIRE SENSOR LIGHT (Amber) (4)

On - indicates a fault exists on one of the two fire detection loops of the engine.
Accompanied by a MWS ENG (amber).

FIRE SENSORS SELECTOR (4)

A or B - the other loop is inhibited and the engine fire warnings are armed to operate from the selected loop.

BOTH - both engine fire detection loops are detecting and the engine fire warnings are armed to operate only if both loops detect a fire.

FLAME SENSORS SELECTOR (4)

A or B - the other loop is inhibited, the FLAME SENSOR light is inhibited and the engine overheat warnings are armed to operate from the selected loop.

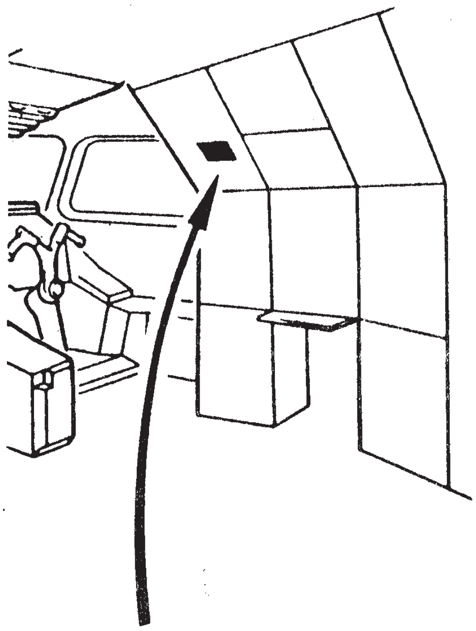
BOTH - both the combustion chamber flame breakout detection loops are detecting and the engine overheat warnings are armed to operate only if both loops detect a flame breakout.

FLAME SENSOR LIGHT (Amber) (4)

On - with the FLAME SENSOR selector at BOTH, indicates that one of the two engine flame breakout detection loops is signalling a warning.
Accompanied by a MWS ENG (amber).

(Deletion)

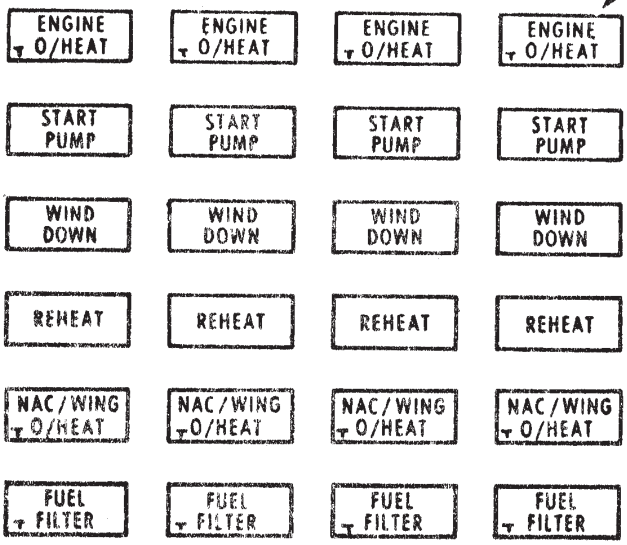
ENGINE WARNING LIGHTS



ENGINE O/HEAT LIGHT (Red)(4)

On - indicates that a high temperature exists at:-

No 2 and No 3 bearings air vent or
No 4 and No 5 bearings cold vent or
No 5 bearing hot vent or
No 12 labyrinth seal vent or
a comustion chamber flame breakout exists.
Accompanied by an Engine Shut Down Handle light (red) and a MWS ENG (red).



START PUMP LIGHT (Yellow) (4)

Refer to POWER PLANT

WIND DOWN LIGHT (Yellow) (4)

Refer to POWER PLANT

REHEAT FAULT LIGHT (Yellow) (4)

Refer to POWER PLANT

FUEL FILTER LIGHT (Amber) (4)

Refer to POWER PLANT

NAC/WING O/HEAT LIGHT (Amber) (4)

On - indicates an overheat condition in the wing rear equipment bay over an engine or in an engine bay.

Accompanied by a MWS ENG (amber)

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Chapter 9

FLIGHT CONTROLS

(ATA CHAPTER 27)

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FLIGHT CONTROLS

GENERAL

The aircraft is controlled in pitch and roll by elevons and in yaw by rudders. Each control surface is independently operated by a Power Flying Control Unit (PFCU).

The three elevons, on each side of the aircraft, are in two groups: the outer and middle elevons because their deflection angles are always synchronised, and the inner elevons because their deflection angles in the roll axis are less than that of the outer and middle elevons.

FLIGHT CONTROL CHANNELS

Conventional flight deck controls actuate three signal channels; two electrical (one called Blue and the other Green) and one Mechanical.

Each electrical flying control channel is supplied from its own inverter which has the same colour code as the channel it supplies. The electrical signalling operates at a different frequency from the main aircraft system.

On both blue and green electrical channels pilot control movements generate, by means of synchro transmitters called resolvers, electrical signals that directly control the PFC servos. Each flight control group, middle and outer elevons, inner elevons and rudders, operates independently through its own resolvers that also ensure the pitch and roll mixing for the elevons.

The mechanical channel also transmits pilot control movements to the PFC servos but is unclutched at the servos when either electrical channel is operating.

Three signals, blue, green and mechanical are therefore available at the PFC servos but only one is activated by the monitoring system that monitors the operation of the control surfaces by groups.

On the mechanical channel of each flight control axis pilot control movements are transmitted to the PFC servos by linkages and cables through a relay jack that compensates for linkage inertia.

Pitch and roll inputs are mixed by a mechanical mixing unit downstream of the pitch and roll relay jacks. This unit also provides in roll the reduced deflection of the inner elevons in order to minimise the aerodynamic interference of the elevons on the fin and rudder and hence the yaw moment in roll. The deflection angles in roll/pitch mixing are limited by mechanical stops such that at full pitch deflection 2.9 degrees of roll deflection are available.

The control surface deflection angles are limited by mechanical stops on the forward and rear mixing unit and on the individual power flying control units.

Maximum stops (mixing unit)

YAW	(rudder)		± 30°
PITCH	(inner elevons)	*	15° UP, 17° DOWN
	(outer/middle elevons)	*	15° UP, 17° DOWN
ROLL	(inner elevons)		14° UP, 14° DOWN
	(outer/middle elevons)		20° UP, 20° DOWN

* The pitch nose up stop of 15° UP can be overidden by pulling more on the control column in order to obtain 17° UP if needed.

The pitch and roll mixing permits additional deflection capability up to mechanical stops on the PFCU's.

Maximum stops (PFCU)

Inner elevons	19° UP, 19° DOWN
Outer/middle elevons	23½° UP, 23½° DOWN

HYDRAULIC SUPPLIES

The PFCUs, relay jacks and artificial feel units are normally supplied with pressure from blue and green hydraulic systems. In the case of the PFCUs and relay jacks only, the yellow standby system may be selected to replace either a failed blue or green main system. Control of these supplies is through selection on the SERVO CONTROLS panel.

FLIGHT CONTROL MONITORING AND COMPARISON

The monitoring system monitors

- flight control inverters
- hydraulic systems pressure to the flight controls
- operation of the servo controls
- operation of the electrical control channels

The monitoring system will automatically reject a flight control channel suffering a failure in these systems and change to the next available channel.

The comparator monitors the pilot (or autopilot) input and surface displacement. Channel changeover will take place when these disagree except when the difference is due to a high rate of input or the surface fails to correspond correctly because of high aerodynamic loads.

FLIGHT CONTROLS

OUTER ELEVON NEUTRALISATION

In order to avoid lateral control reversal in the transonic region at high indicated airspeeds, the neutralisation system returns the outer elevons to the zero position at V_{MO} plus 25 knots. To avoid aircraft disturbance during initiation and removal of the neutralization signal, a short time delay is incorporated to provide a progressive transition.
The outer elevon neutralization function only operates in the Blue and Green electrical channels. In mechanical channel, control position is unaffected.

RELAY JACKS

Each relay jack is a twin-ram electro-hydraulic actuator. Each ram displacement in speed and direction is controlled by a spool valve. Each spool valve jamming is monitored by a detector, linked to the BLUE light if the corresponding ram is supplied by the blue hydraulic system or the GREEN light if the ram is supplied by the green hydraulic system.

The detection of a jammed condition automatically signals the relevant relay jack hydraulic selector to shut, thus removing hydraulic power (normal or standby) from the jammed side of the relay jack. This automatic shut-off ensures that a flight control axis cannot be frozen by this single jack failure.

Each relay jack is also used as an auto-pilot input point.

POWER FLIGHT CONTROL UNIT (PFCU)

Each flight control surface is actuated by an electro-hydraulic twin-ram servo control. Each servo control ram displacement in speed and direction is controlled by a spool valve. Each spool valve jamming is monitored by a detector, linked to the BLUE JAM light if the corresponding ram is supplied by the blue hydraulic system or the GREEN JAM light if the ram is supplied by the green hydraulic system.

When a servo control ram spool valve other than the one being signalled jams, the microswitches between the spools are operated by movement of the other valve and signal a jam on the faulty half body. Should it be the valve being signalled which jams, an automatic changeover to the next available signalling channel will occur accompanied by the appropriate valve jam signal.

AUTO-STABILIZATION

The auto-stabilization system improves the natural stability of the aircraft. It minimizes the effect of turbulence and reduces the resulting flight path disturbance following an engine failure.

The auto-stabilization system comprises two separate channels for each control axis, pitch, roll and yaw. Each axis of each channel is engaged by a separate switch during normal operation. Both channels of each axis are engaged with channel 1 having control authority and channel 2 being in a synchronized standby condition.

The auto-stabilization system generates signals in pitch roll and yaw as a function of aircraft rate of movement and mach number from the ADC.

These signals are independently supplied through both electrical channels direct to the PFCU servos with no feedback to the pilot controls.

In addition to the basic auto-stabilization the system also provides a roll/yaw turn co-ordination function that reduces the side slip angles at slow speed in response to large lateral control demands.

Auto-stabilization No.1, although normally linked to the Blue electrical channel will automatically control through the Green electrical channel in event of failure of the Blue electrical channel.
Auto-stabilization No.2 operates similarly.

ARTIFICIAL FEEL

The artificial feel system comprises two separate channels for each control axis, pitch, roll and yaw. Each axis of each channel is engaged by a separate switch. During normal operation both channels of each axis are engaged, but on each axis a rocking lever linked to both channel jacks gives channel 1 control authority while channel 2 jack is held to its lower stop.

Artificial feel is provided on each control axis pitch, roll and yaw by a spring rod that increases the control stiffness with increasing control deflection supplemented by dual control jacks that change the stiffness as a function of speed at speeds above approach speed. Channel 1 jacks are powered by the blue hydraulic system and channel 2 jacks are powered by the green hydraulic system while jack pressures are controlled by speed signals from the ADC.

The pitch artificial feel maintains a constant load factor throughout the flight envelope. The roll artificial feel maintains a constant relationship between roll rate and control wheel force throughout the flight envelope. The YAW artificial feel limits available rudder demand to meet structural limitations.

Blue or green hydraulic system loss, or failure of ADC1 or ADC2, will cause the loss of the associated artificial feel system.

Failure of the artificial feel system No.1 will cause an automatic changeover to artificial feel system No.2 provided it is engaged.

Failure of artificial feel system No.2 will not make any change because artificial feel system No.1 has priority. There is no change in the FEEL force.

The pitch artificial feel channels also provide the stick wobbler function of the anti-stall system. It is thus necessary for artificial feel to be engaged in order that stick wobbler anti-stall protection be available.

TRIM

Conventional trim is provided in Roll, Yaw and Pitch. The trim cancels the load of the artificial feel by changing the feel datum and consequently the neutral position of the flight controls.

An electric trim system is provided only in pitch and comprises two separate but identical channels. Each channel is engaged by a separate engage switch. During normal operations, both channels are engaged with channel 1 having control authority and channel 2 being in a synchronized standby condition.

The electric trim can be controlled either, directly by the pilot using the PITCH TRIM selector on each control column or independently of the pilot, in auto trim when either autopilot is engaged or for automatic pitch stability correction. The same electric trim is used in both cases.

Automatic Pitch Stability Correction
This mode of operation provides the following

1. Mach Trim

   In transonic flight the rearward shift of the centre of pressure reduces pitch stability. To restore pitch stability the mach trim function automatically signals an up elevon demand related to mach number between M = 0.69 and M = 1.34.

2. Incidence Trim

   Incidence Trim compensates for centre of pressure movement due to changes in the aeroplane's angle of attack, it is operative at angles of attack of 10½ degrees and reaches its maximum at 19½ degrees. It has a secondary purpose in that it will increase the stick force required to reach high angles of attack. As the angle of attack increases so the incidence trim applies a nose down pitch trim.

3. Speed Trim

   Pitch stability correction is introduced as a function of airspeed, it complements Mach trim and automatically signals an up elevon demand related to airspeed between 200 knots and 600 knots.

4. Speed Trim (above V_{MO})

To give additional protection beyond V_{MO} a term proportional to the extent by which V_{MO} is exceeded signals an up elevon demand. The term is also proportional to Mach number and is introduced when the aircraft speed is more than 5 knots above V_{MO} and the Mach number is above $M = 1.15$.

The automatic pitch stability correction is also active in autopilot auto trim operation but the forces are masked absorbed by the auto trim.

Failure or disengagement of both electric trim systems causes disengagement of both autopilots except below 100ft.

When the aircraft angle of attack exceeds 14½ degrees the auto pilot auto trim is inhibited, except after glide slope capture, by a signal from the anti-stall system. This inhibition does not cause the electric trim systems or switches to disengage. As the auto pilot disengages at 17½ degrees angle of attack nose down pitch occurs.

HIGH INCIDENCE PROTECTION

High incidence protection is provided by

- Incidence trim
- Stick shaker
- Anti-stall system

Incidence Trim

The Incidence trim is part of the automatic pitch stability correction and operates at angles of attack of 11 degrees and above.

Stick Shaker

A single stick shaker on the captain's control column operates at an angle of attack of 16.5 degrees. Both control columns will shake as the movement is transmitted to the first officers control column through the mechanical linkage. The shaker is signalled from either ADC.

Anti-Stall System

The anti-stall system operates, when engaged, from about 10 seconds after lift off at speeds below 270 knots. At high angle of attack conditions the anti-stall system augments the basic pitch autostabilization with a super stabilization function and creates an unmistakeable warning at the approach to very high angles of attack through the artificial feel.

There are two anti-stall systems, both systems are normally engaged with system 1 having priority whilst system 2 is in a synchronised standby condition.

The super-stabilization function is active at angles of attack greater than 13.5 degrees. It produces a down elevon deflection, through the pitch autostabilization channel, proportional to angle of attack, nose up pitch rate and aircraft deceleration. The deflection is limited to 8 degrees down elevon and 0 degrees up elevon.

The unmistakeable warning (stick wobbler) modulates the pressure in the artificial feel jacks causing both control columns to pulsate against any manual nose up force. The stick wobbler normally operates at an angle of attack of 19 degrees but under dynamic approach to high angle of attack conditions a "phase advance" is invoked that can cause the wobbler to operate at up to 3 degrees before 19 degrees. To prevent the stick wobbler operating before the stick shaker a synchronization signal from the anti-stall system to the stick shaker ensures simultaneous operation under maximum phase advance conditions.

In addition to the basic function, if the conditions for stick wobbler operation happen at less than 140 knots the super-stabilization system commands a simultaneous 4 degrees down elevon.

The stick wobbler is cancelled by pushing the control column forward through the trim neutral position.

Since the superstabilization demands of the anti-stall systems are transmitted through the pitch autostabilization channel the engagement logic of anti-stall is linked to that of the pitch autostabilization system.

EMERGENCY FLIGHT CONTROL

An emergency flight control system provides an additional flight control capability in pitch and roll axes in the event of a control jam between the control column and the relay jacks. This control is achieved by strain gauge bridges, within the control column assembly measuring pitch and roll forces, demanded by the pilot against the jam, and injecting these signals directly into the electrical flight control channels. There is no emergency flight control in yaw.

The control signals are transmitted through the autostabilization pitch and roll channels into the electrical flying control channels. It is therefore necessary for the autostabilization pitch and roll channels to be engaged and healthy with flight controls in an electrical channel. To prevent disconnection of the electrical flying controls through surface comparator action the comparators are inhibited when emergency flight control is engaged.

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There are two systems, once the systems are engaged System 1 takes priority with System 2 in a synchronized standby condition. If System 1 fails control will automatically switch to System 2 and No.1 Autostabilization pitch and roll channels will disengage.

The control forces experienced are similar to those with the artificial feel system switched off, i.e. only the spring rod operating. Since both pitch and roll are engaged simultaneously a jam affecting one axis will result in the strain gauge signals being added to the normal control commands in the other axis.

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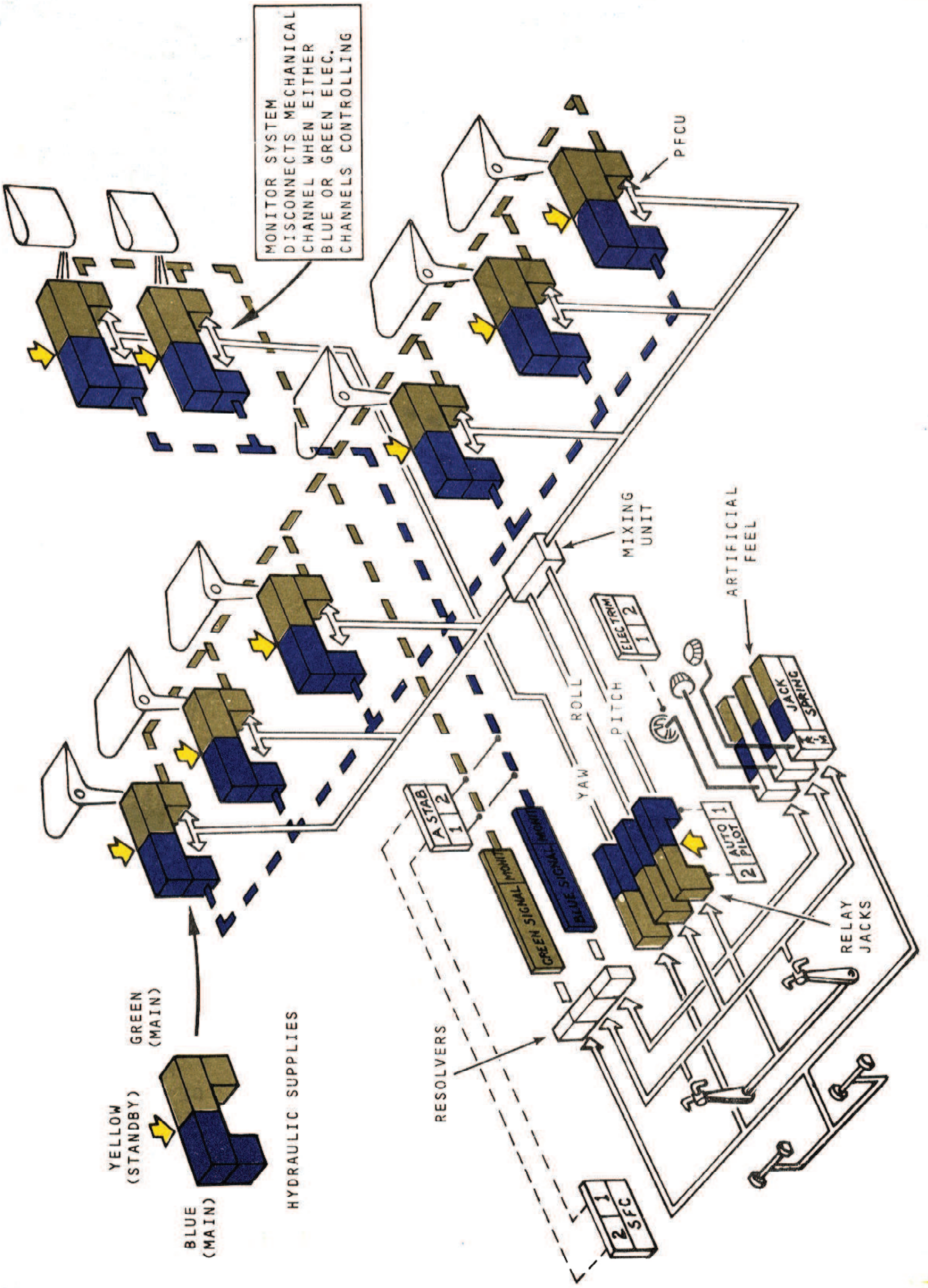
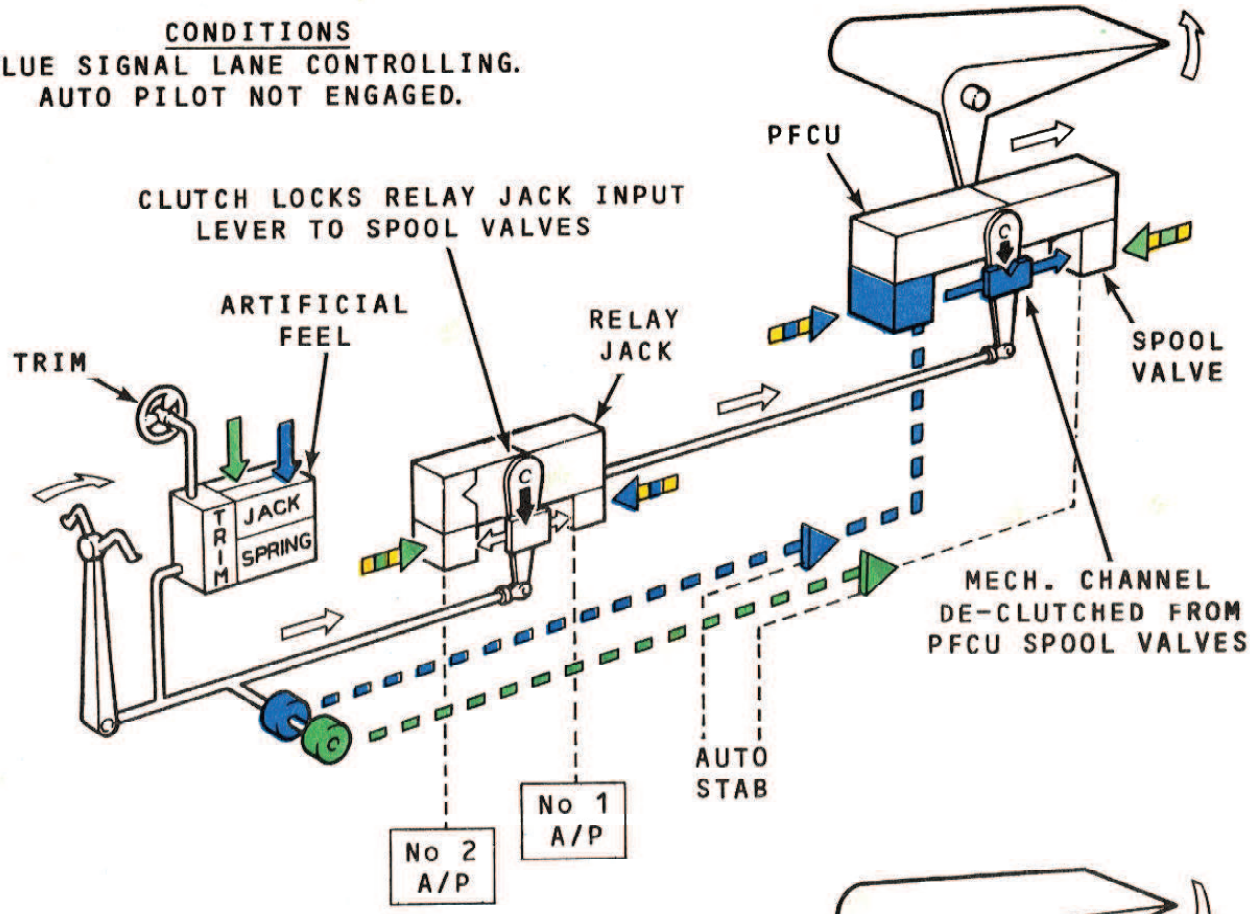
SCHEMATIC LAYOUT

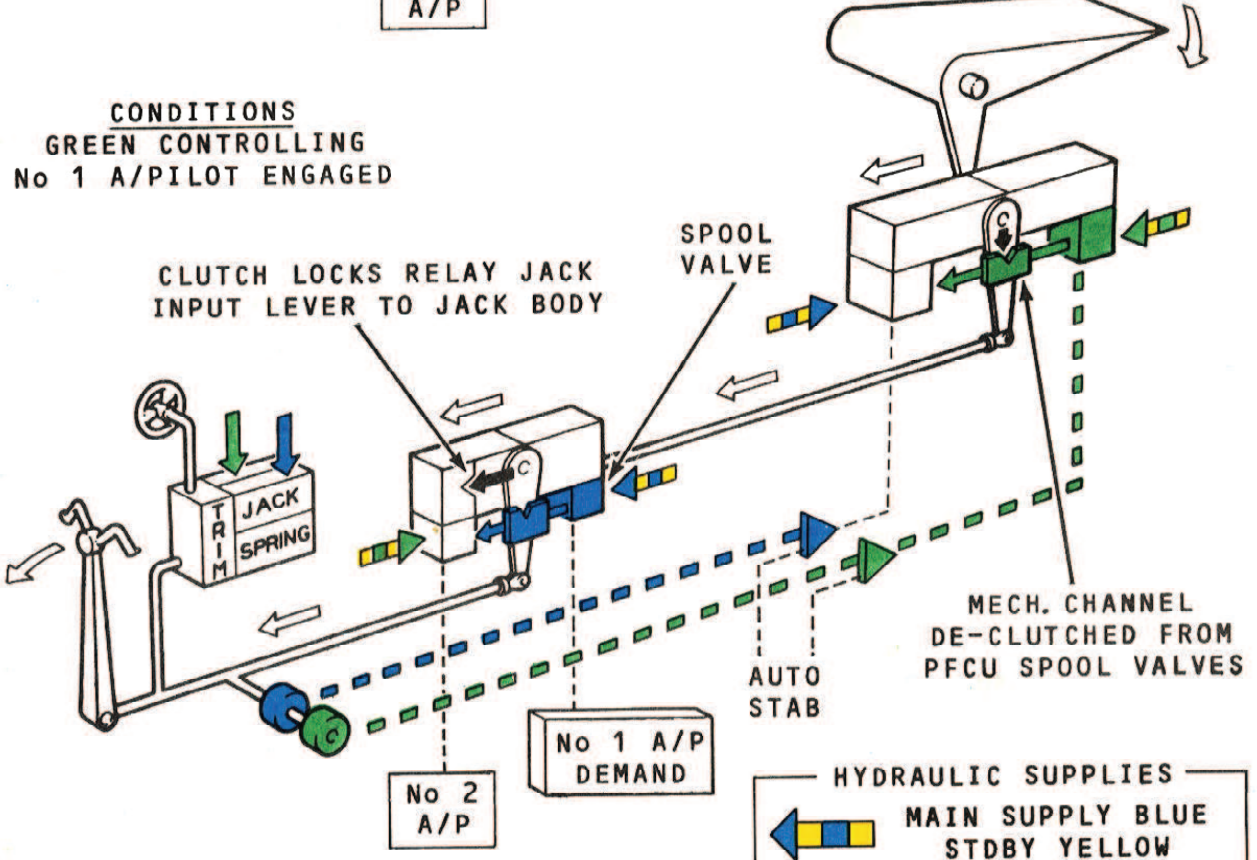


BASIC CONTROL SYSTEM (Sheet 1 of 3)



CONDITIONS
BLUE SIGNAL LANE CONTROLLING.
AUTO PILOT NOT ENGAGED.

PFCU
CLUTCH LOCKS RELAY JACK INPUT LEVER TO SPOOL VALVES
ARTIFICIAL FEEL
RELAY JACK
TRIM
T R I M
JACK
SPRING
C
SPOOL VALVE
MECH. CHANNEL DE-CLUTCHED FROM PFCU SPOOL VALVES
AUTO STAB
No 1 A/P
No 2 A/P



CONDITIONS
GREEN CONTROLLING
No 1 A/PILOT ENGAGED

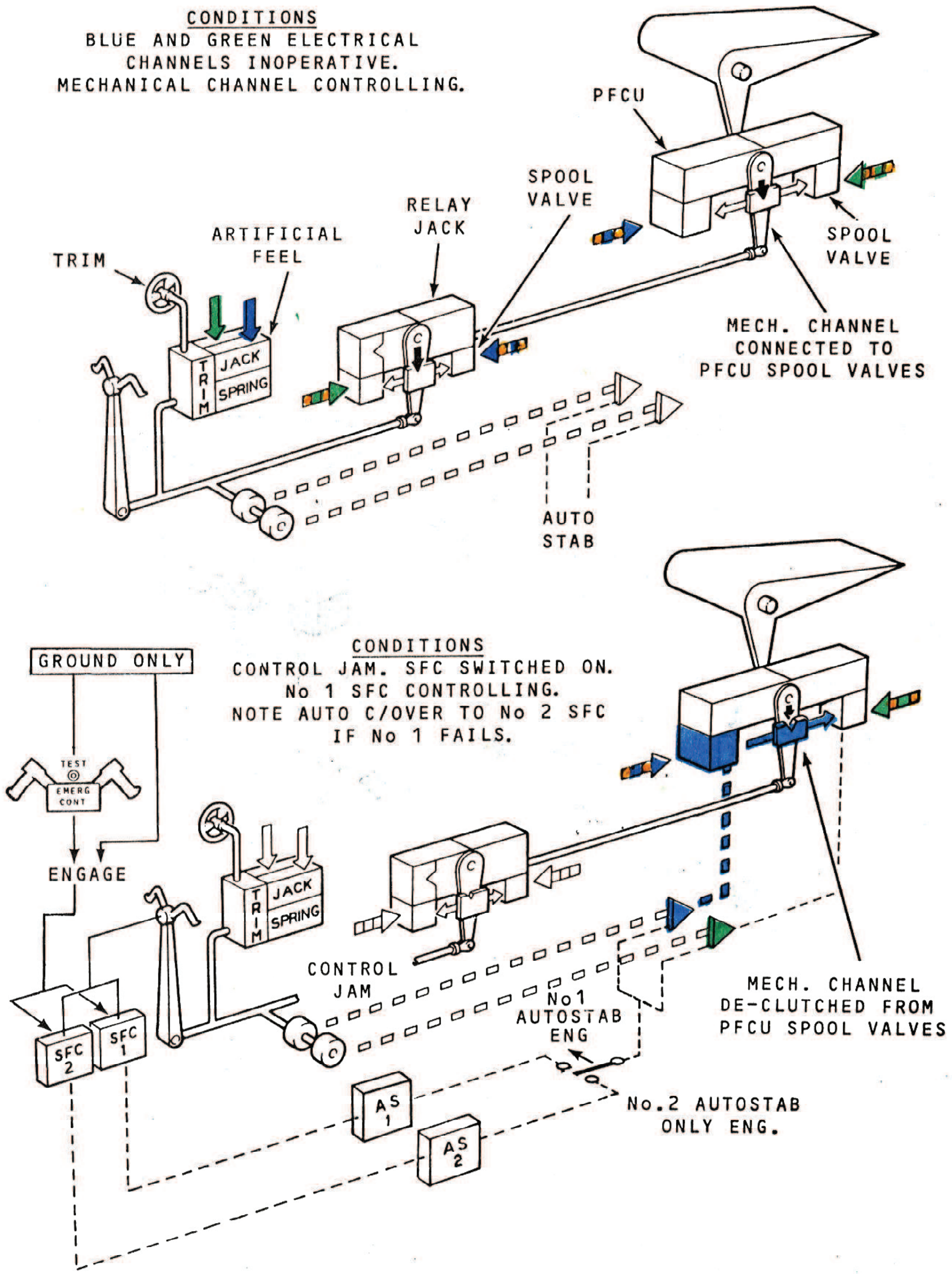
SPOOL VALVE
CLUTCH LOCKS RELAY JACK INPUT LEVER TO JACK BODY
T R I M
JACK
SPRING
C
MECH. CHANNEL DE-CLUTCHED FROM PFCU SPOOL VALVES
AUTO STAB
No 1 A/P DEMAND
No 2 A/P

HYDRAULIC SUPPLIES

◀🟨🟦🟦	MAIN SUPPLY BLUE STDBY YELLOW
◀🟨🟩🟩	MAIN SUPPLY GREEN STDBY YELLOW

NOTE:- ELEVON PITCH CONTROL SHOWN ONLY

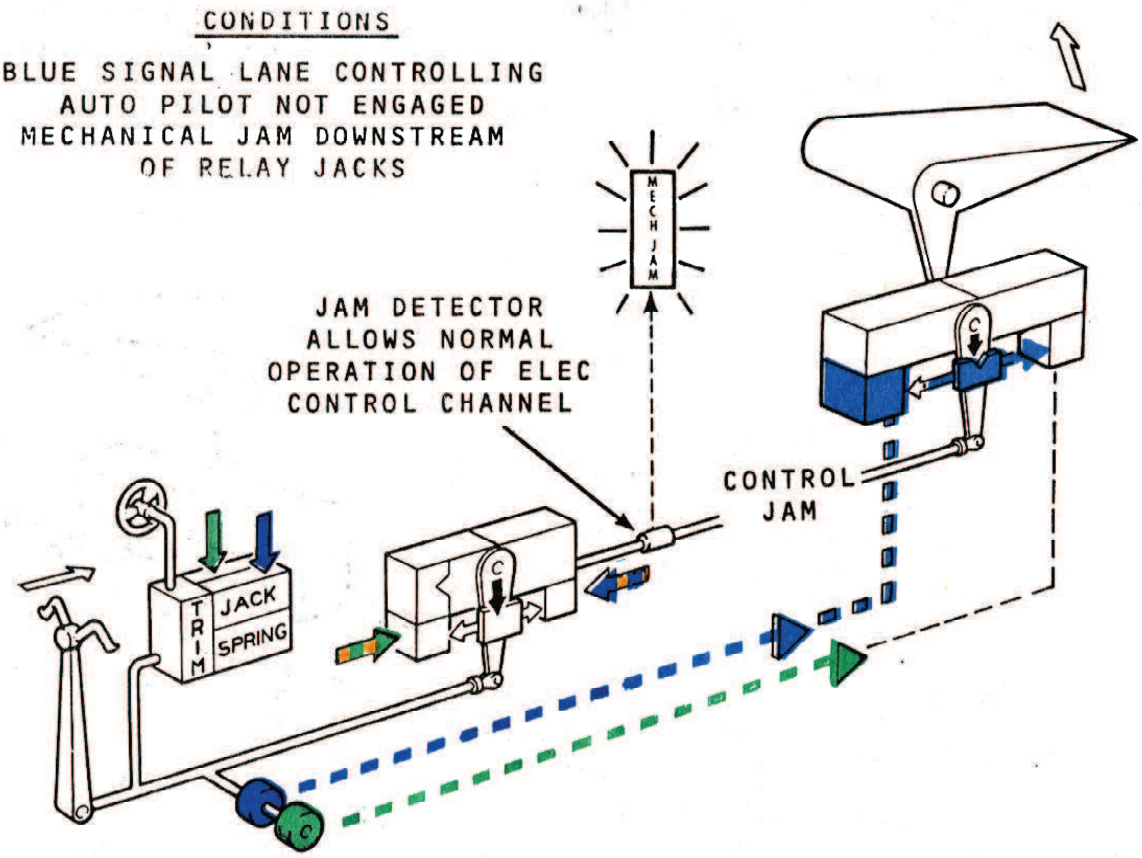
BASIC CONTROL SYSTEM (Sheet 2 of 3)



CONDITIONS
BLUE AND GREEN ELECTRICAL CHANNELS INOPERATIVE.
MECHANICAL CHANNEL CONTROLLING.

CONDITIONS
CONTROL JAM. SFC SWITCHED ON.
No 1 SFC CONTROLLING.
NOTE AUTO C/OVER TO No 2 SFC IF No 1 FAILS.

BASIC CONTROL SYSTEM (Sheet 3 of 3)



CONDITIONS

BLUE SIGNAL LANE CONTROLLING
AUTO PILOT NOT ENGAGED
MECHANICAL JAM DOWNSTREAM
OF RELAY JACKS

JAM DETECTOR
ALLOWS NORMAL
OPERATION OF ELEC
CONTROL CHANNEL

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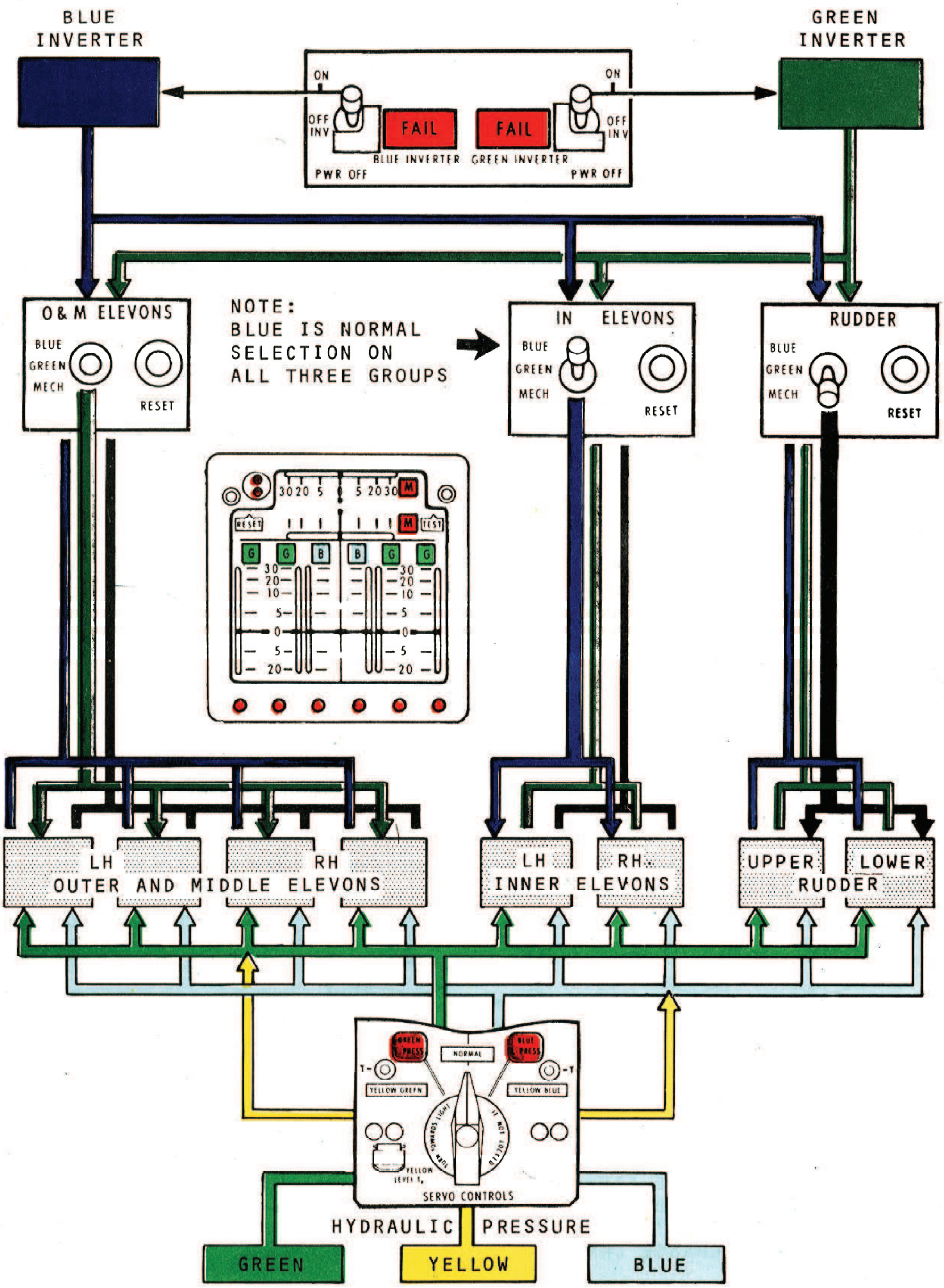
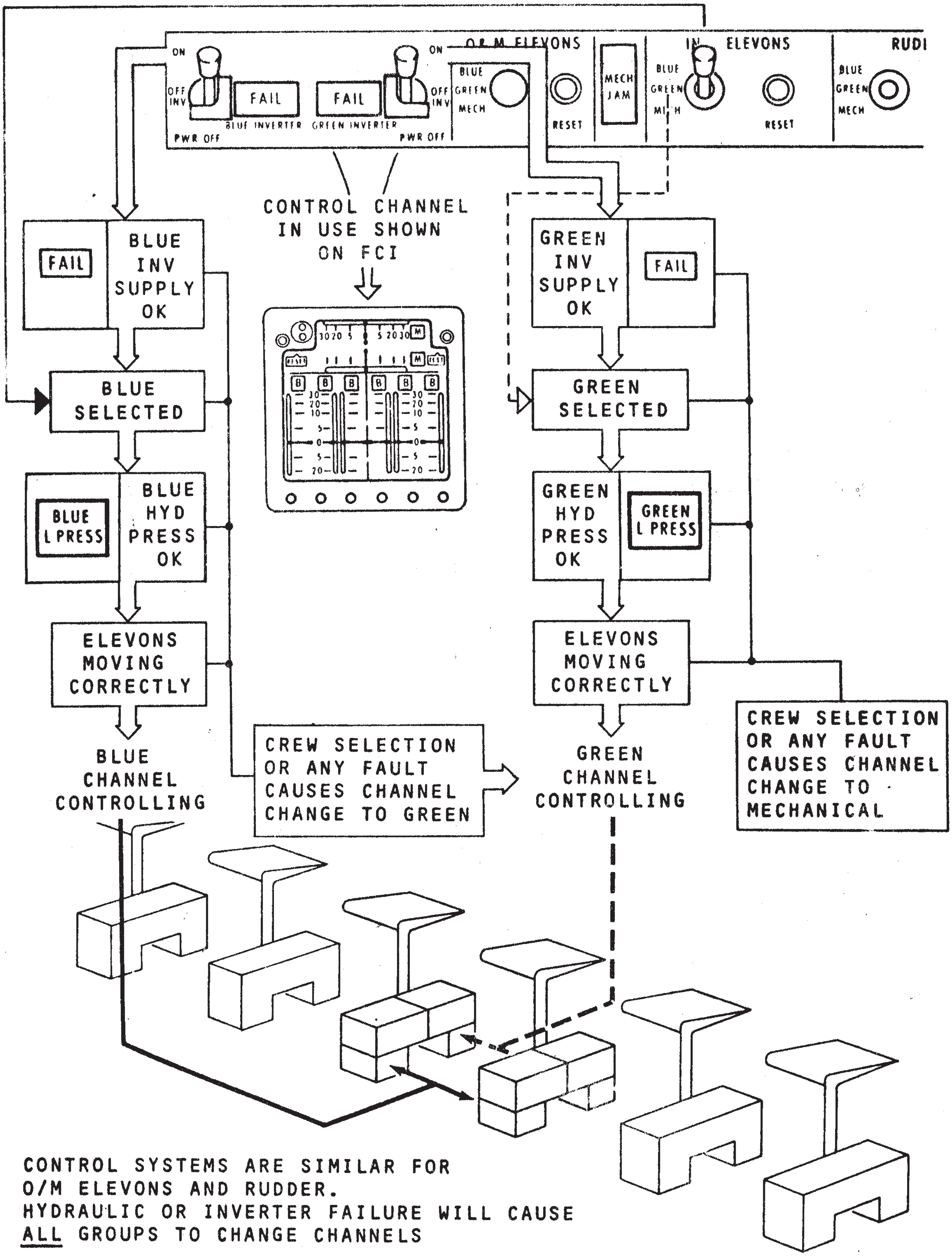
BASIC PFCU SIGNALLING AND HYDRAULIC CONTROL



NOTE:
BLUE IS NORMAL
SELECTION ON
ALL THREE GROUPS

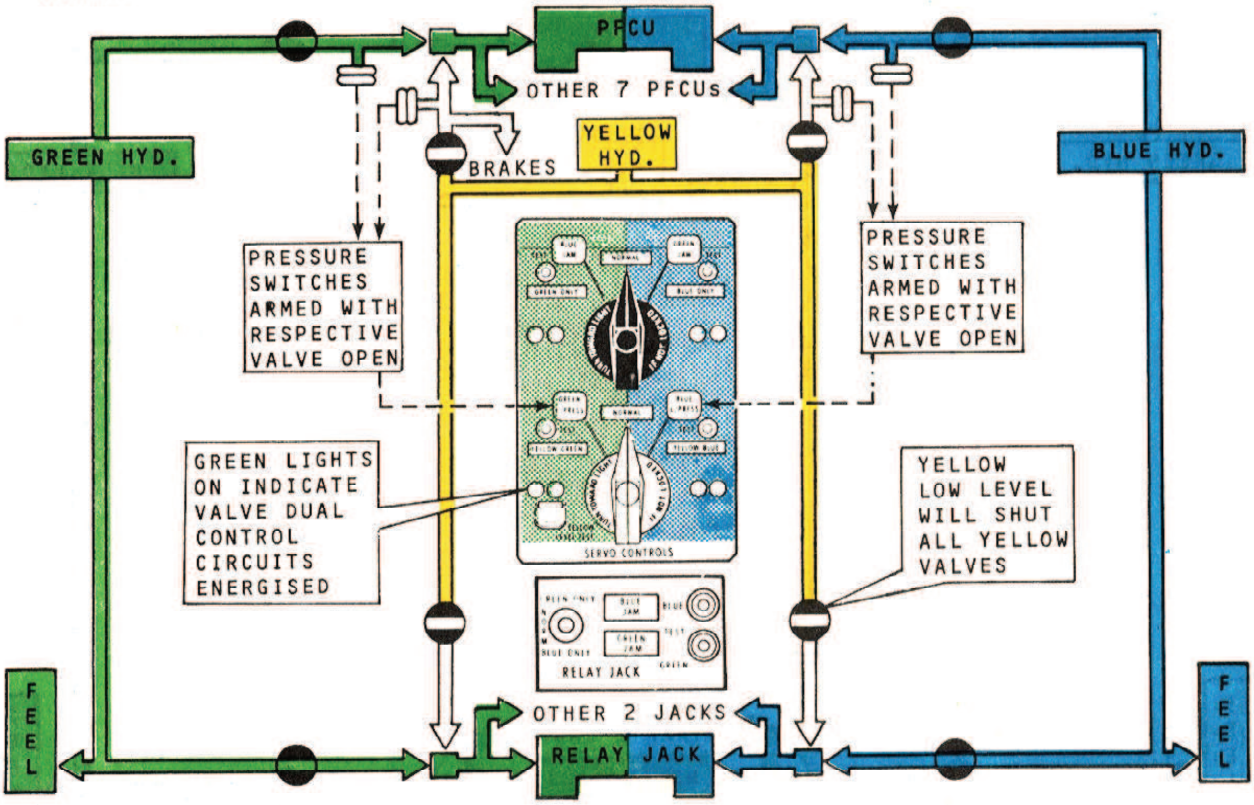
CONTROL AND SIGNALLING INNER ELEVONS



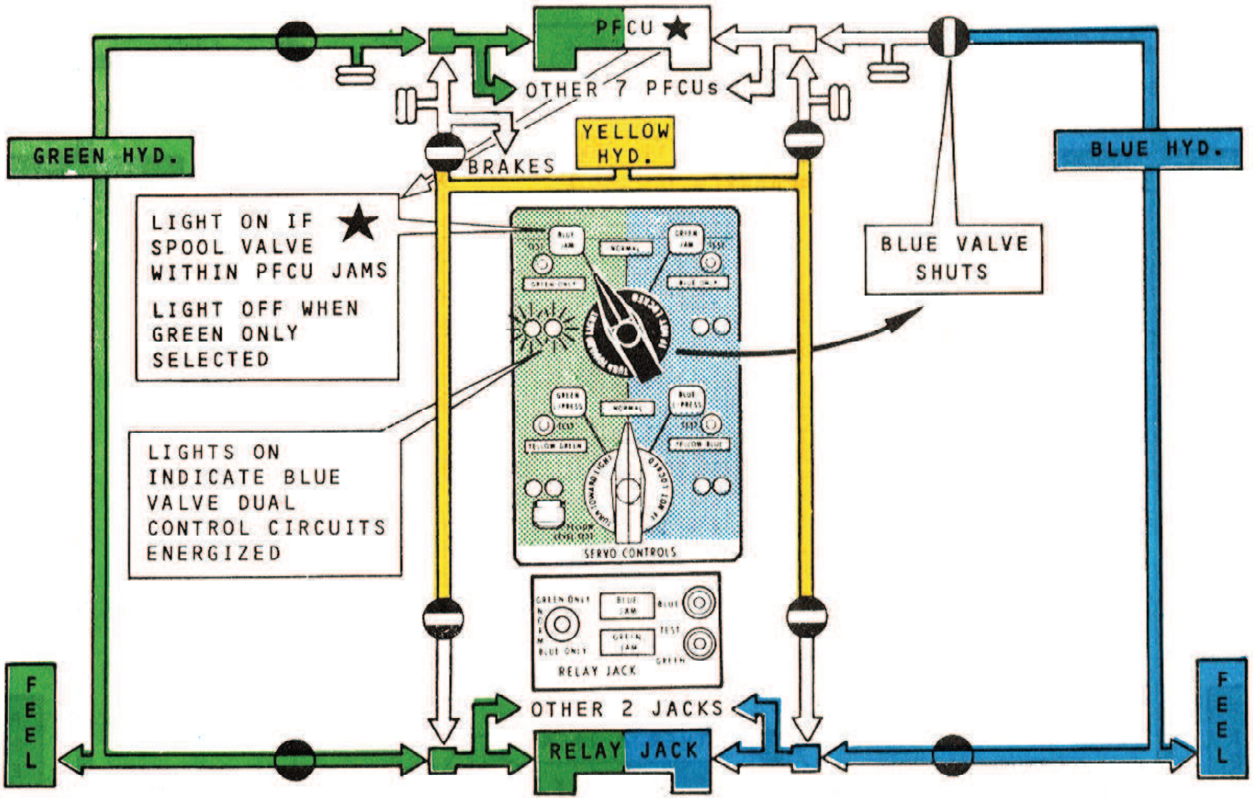
CONTROL SYSTEMS ARE SIMILAR FOR O/M ELEVONS AND RUDDER.
HYDRAULIC OR INVERTER FAILURE WILL CAUSE ALL GROUPS TO CHANGE CHANNELS

HYDRAULIC SUPPLIES (Sheet 1 of 2)

NORMAL CONDITION


PFCU
OTHER 7 PFCUs
BRAKES
YELLOW HYD.
GREEN HYD.
BLUE HYD.
PRESSURE SWITCHES ARMED WITH RESPECTIVE VALVE OPEN
PRESSURE SWITCHES ARMED WITH RESPECTIVE VALVE OPEN
GREEN LIGHTS ON INDICATE VALVE DUAL CONTROL CIRCUITS ENERGISED
YELLOW LOW LEVEL WILL SHUT ALL YELLOW VALVES
SERVO CONTROLS
RELAY JACK
OTHER 2 JACKS
RELAY JACK
FEEL
FEEL

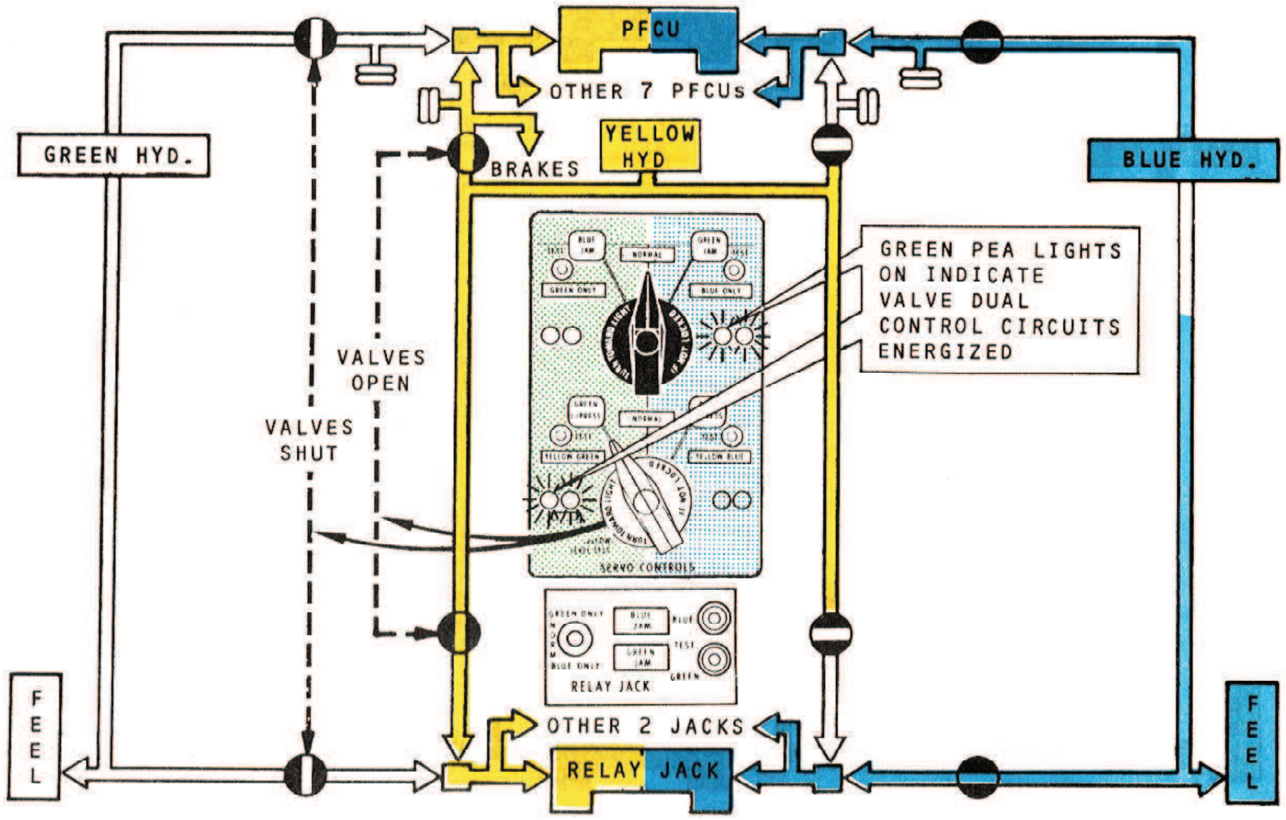
GREEN ONLY SELECTED


PFCU ★
OTHER 7 PFCUs
BRAKES
YELLOW HYD.
GREEN HYD.
BLUE HYD.
LIGHT ON IF ★ SPOOL VALVE WITHIN PFCU JAMS
LIGHT OFF WHEN GREEN ONLY SELECTED
BLUE VALVE SHUTS
LIGHTS ON INDICATE BLUE VALVE DUAL CONTROL CIRCUITS ENERGIZED
SERVO CONTROLS
RELAY JACK
OTHER 2 JACKS
RELAY JACK
FEEL
FEEL

(unchanged)

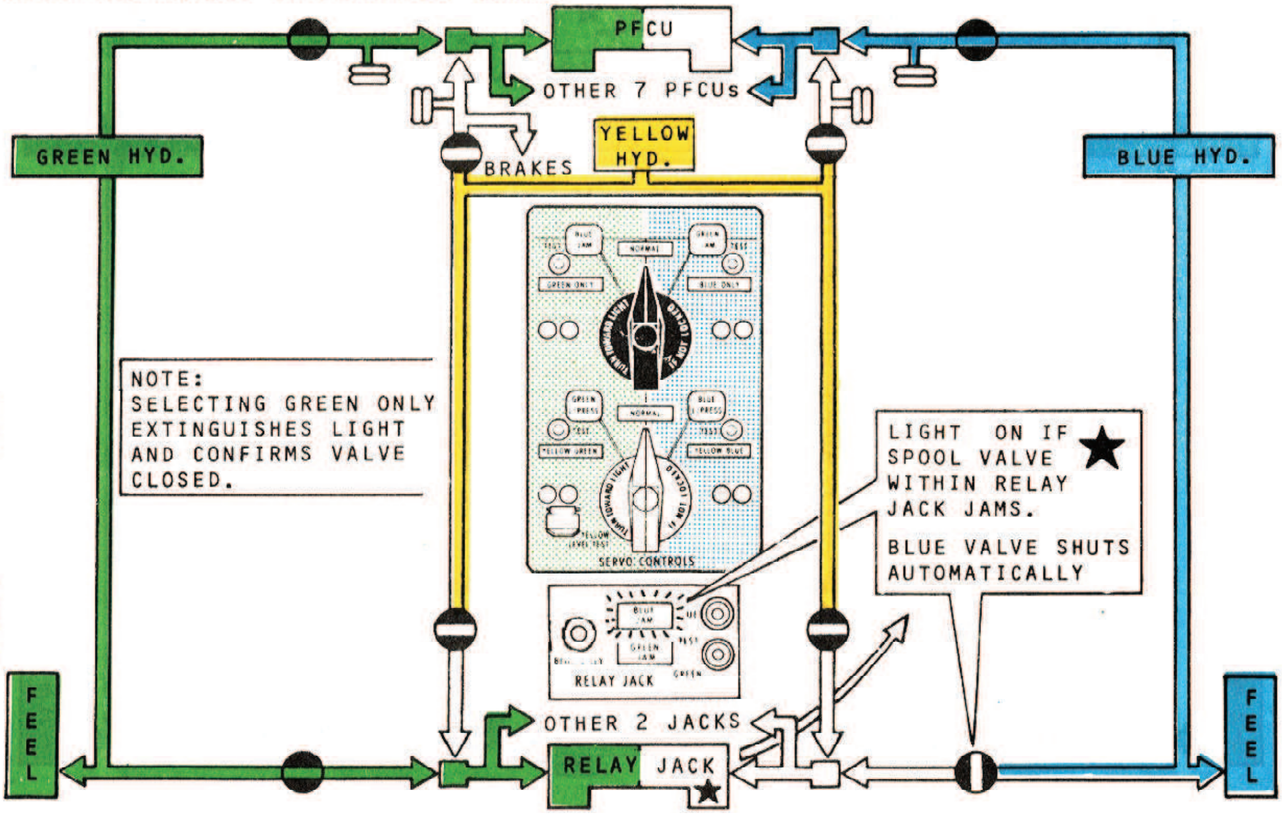
HYDRAULIC SUPPLIES (Sheet 2 of 2)

YELLOW/GREEN SELECTED



GREEN PEA LIGHTS ON INDICATE VALVE DUAL CONTROL CIRCUITS ENERGIZED

RELAY JACK SPOOL VALVE (BLUE) JAMMED

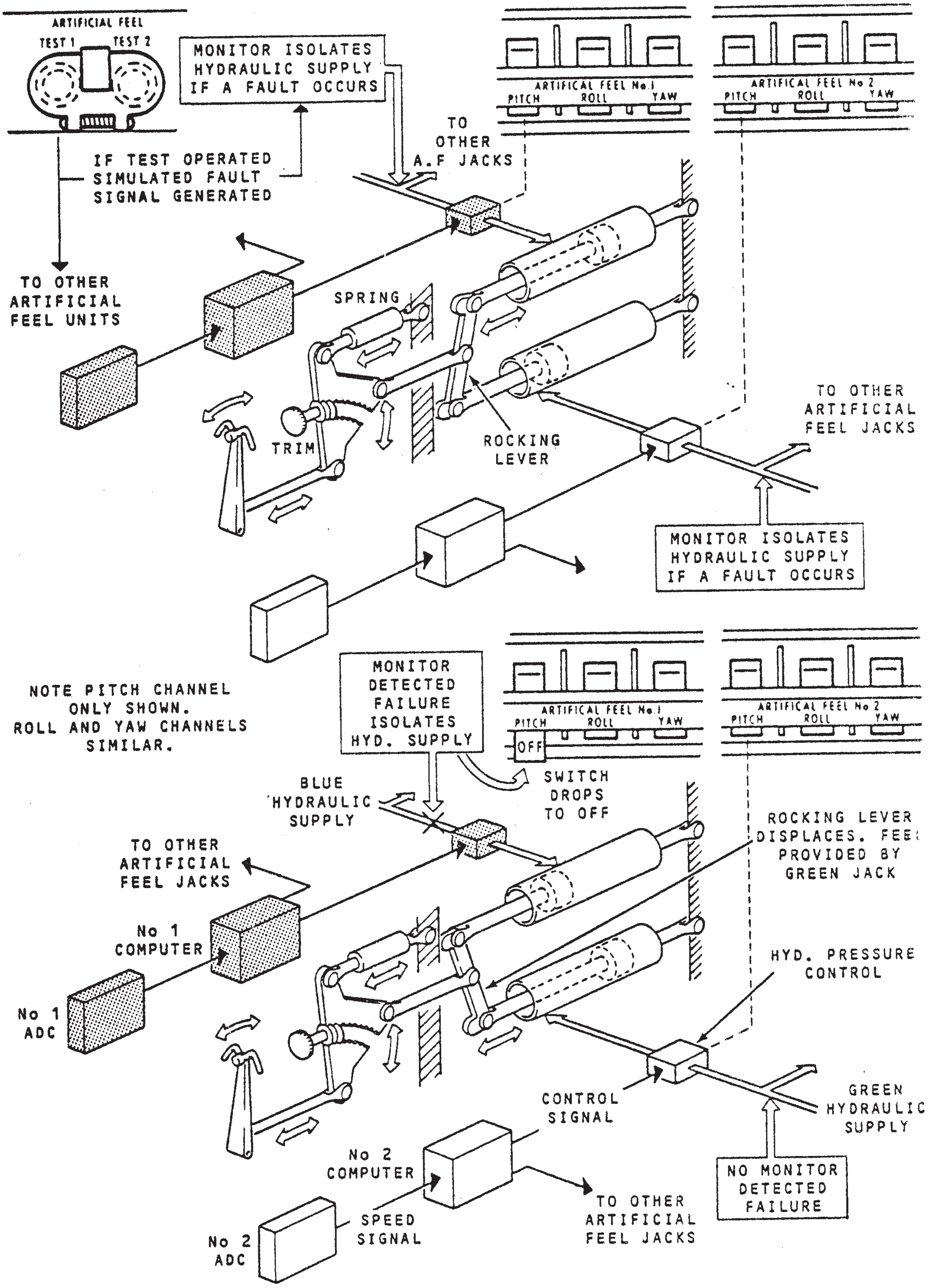


NOTE:
SELECTING GREEN ONLY EXTINGUISHES LIGHT AND CONFIRMS VALVE CLOSED.

LIGHT ON IF SPOOL VALVE WITHIN RELAY JACK JAMS. ★

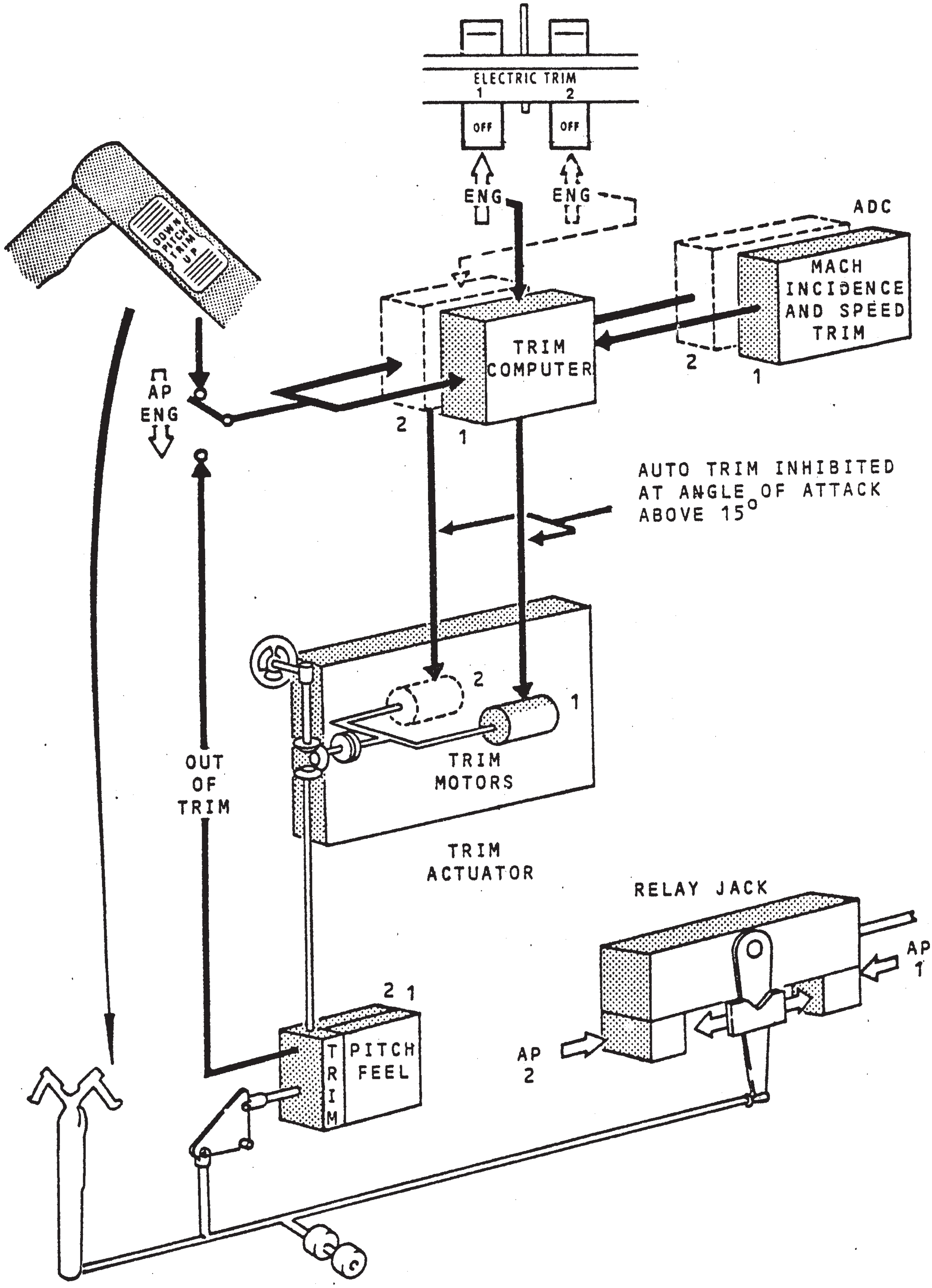
BLUE VALVE SHUTS AUTOMATICALLY

ARTIFICIAL FEEL - SCHEMATIC OPERATION

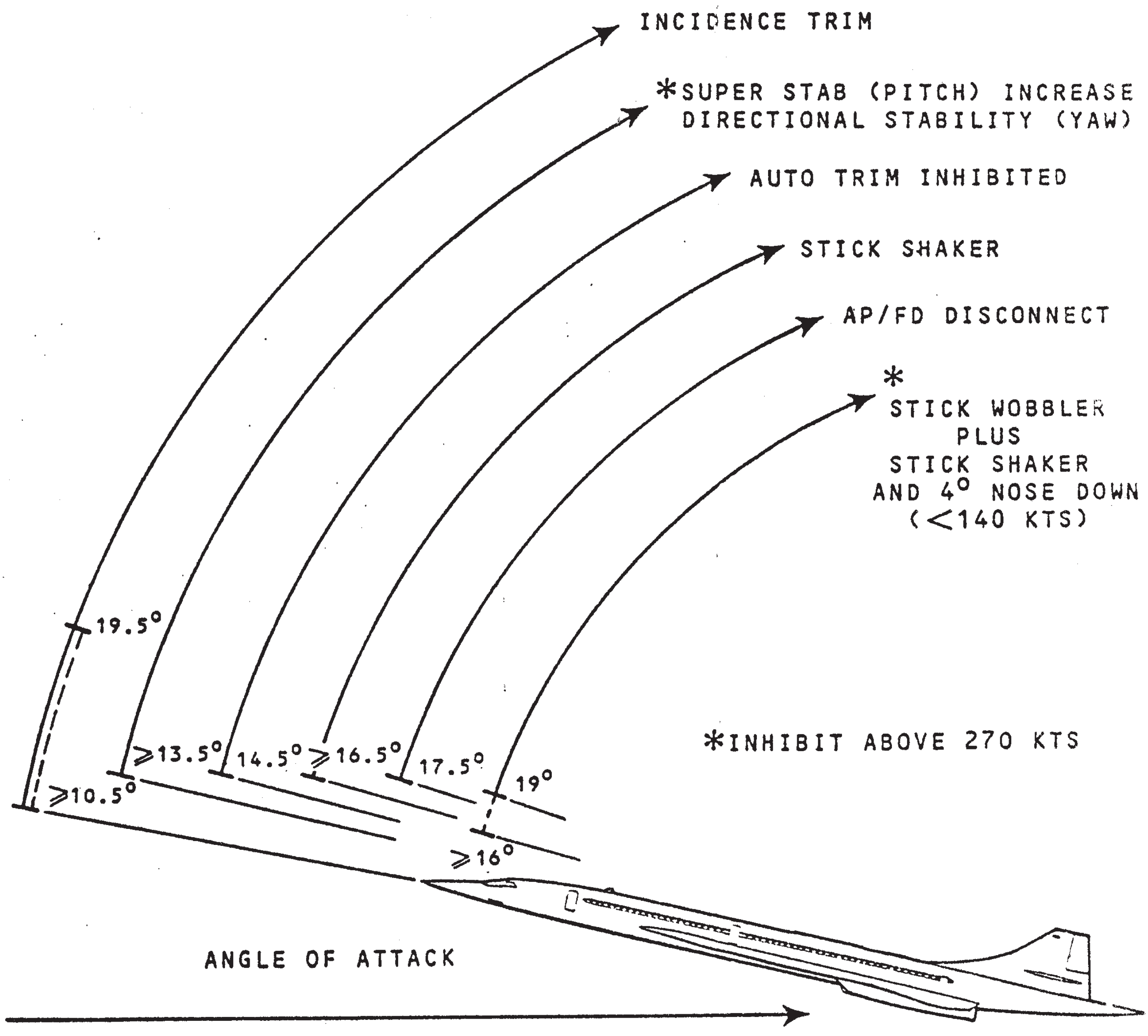

ARTIFICIAL FEEL
TEST 1
TEST 2
MONITOR ISOLATES HYDRAULIC SUPPLY IF A FAULT OCCURS
ARTIFICAL FEEL No.1
PITCH
ROLL
YAW
ARTIFICAL FEEL No 2
PITCH
ROLL
YAW
TO OTHER A.F JACKS
IF TEST OPERATED SIMULATED FAULT SIGNAL GENERATED
TO OTHER ARTIFICIAL FEEL UNITS
SPRING
TRIM
ROCKING LEVER
TO OTHER ARTIFICIAL FEEL JACKS
MONITOR ISOLATES HYDRAULIC SUPPLY IF A FAULT OCCURS
NOTE PITCH CHANNEL ONLY SHOWN. ROLL AND YAW CHANNELS SIMILAR.
MONITOR DETECTED FAILURE ISOLATES HYD. SUPPLY
ARTIFICAL FEEL No.1
PITCH
ROLL
YAW
OFF
ARTIFICAL FEEL No 2
PITCH
ROLL
YAW
SWITCH DROPS TO OFF
BLUE HYDRAULIC SUPPLY
ROCKING LEVER DISPLACES. FEEL PROVIDED BY GREEN JACK
TO OTHER ARTIFICIAL FEEL JACKS
No 1 COMPUTER
No 1 ADC
HYD. PRESSURE CONTROL
CONTROL SIGNAL
GREEN HYDRAULIC SUPPLY
No 2 COMPUTER
NO MONITOR DETECTED FAILURE
TO OTHER ARTIFICIAL FEEL JACKS
SPEED SIGNAL
No 2 ADC

(Unchanged)

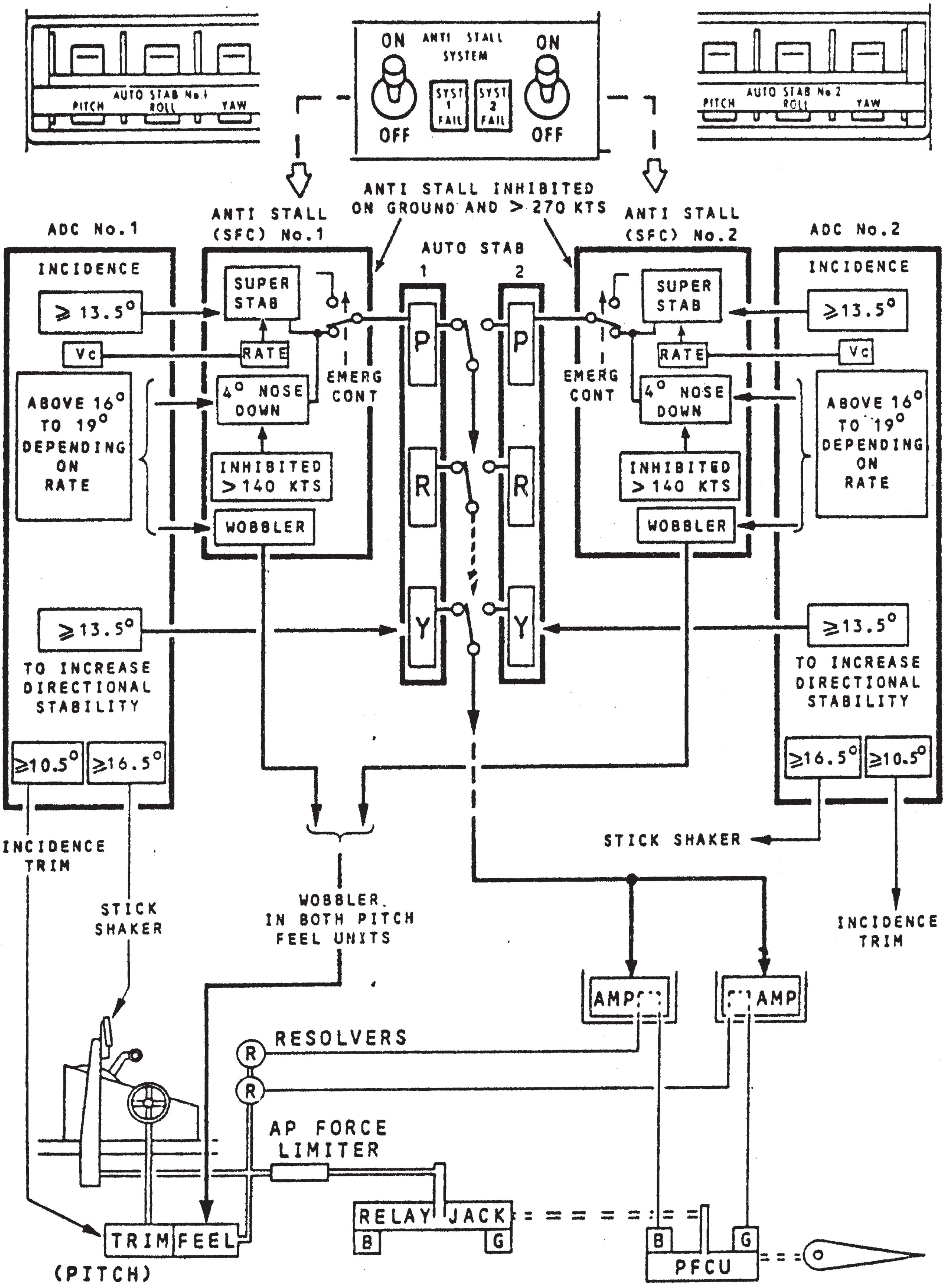
ELECTRIC TRIM



HIGH INCIDENCE WARNING & PROTECTION

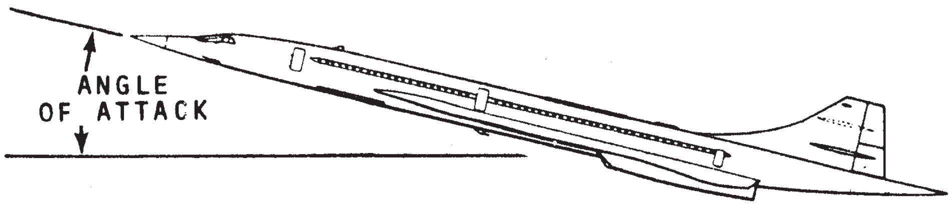


HIGH INCIDENCE WARNING & PROTECTION



ANTI STALL SYSTEM

19° UNMISTAKABLE WARNING
16.5° STICK SHAKER
13.5° SUPER STAB
(NOSE DOWN)



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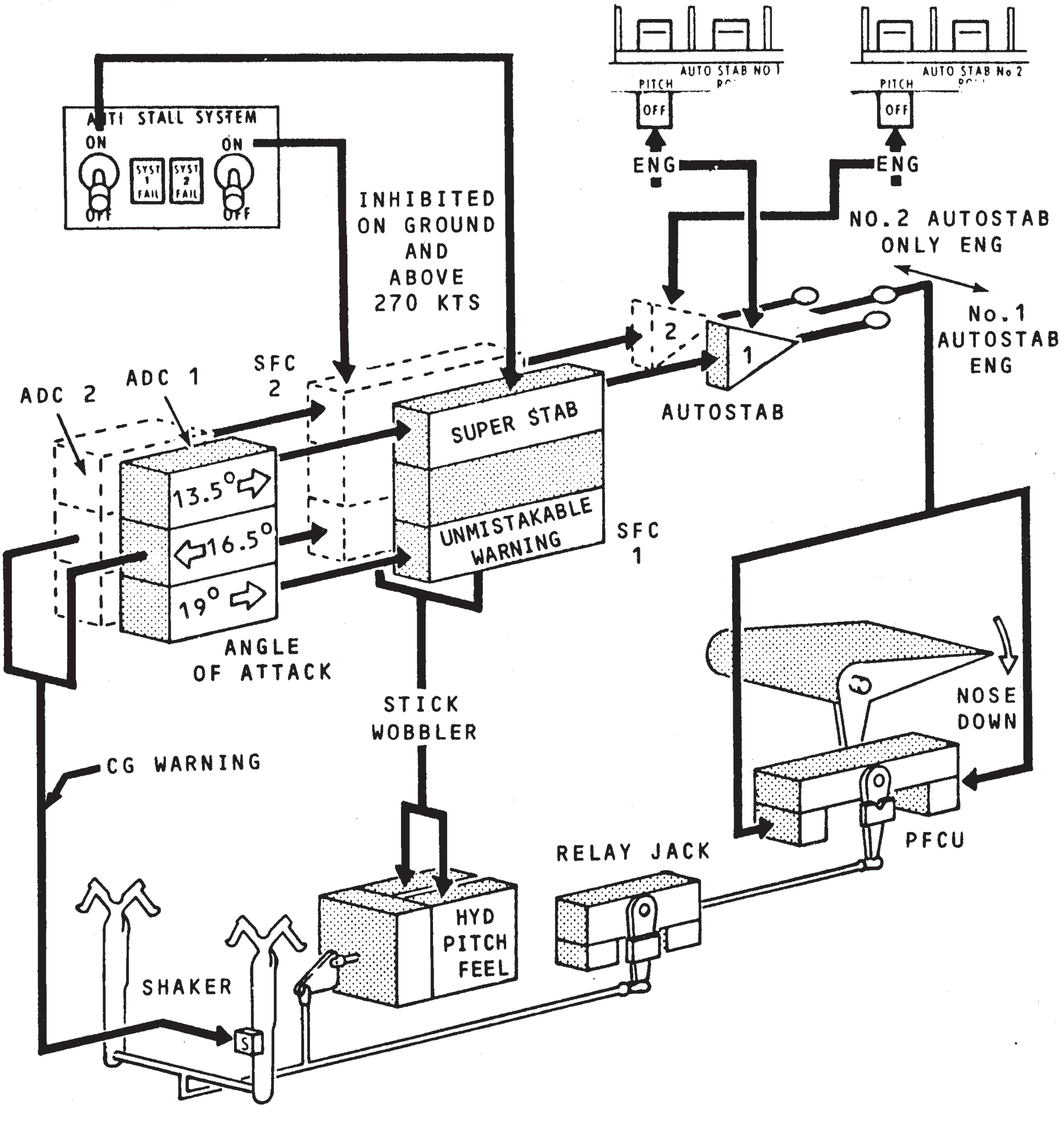
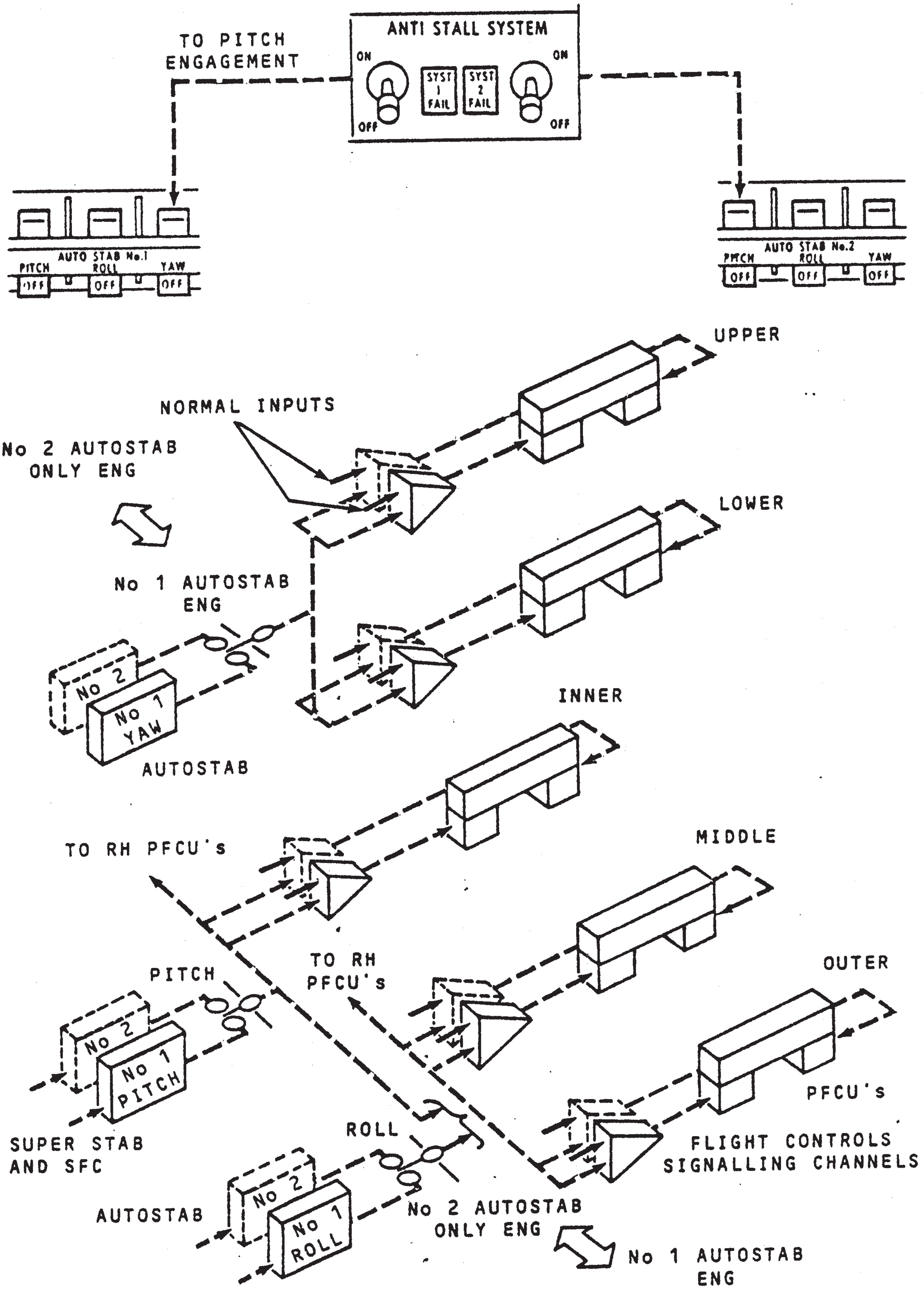
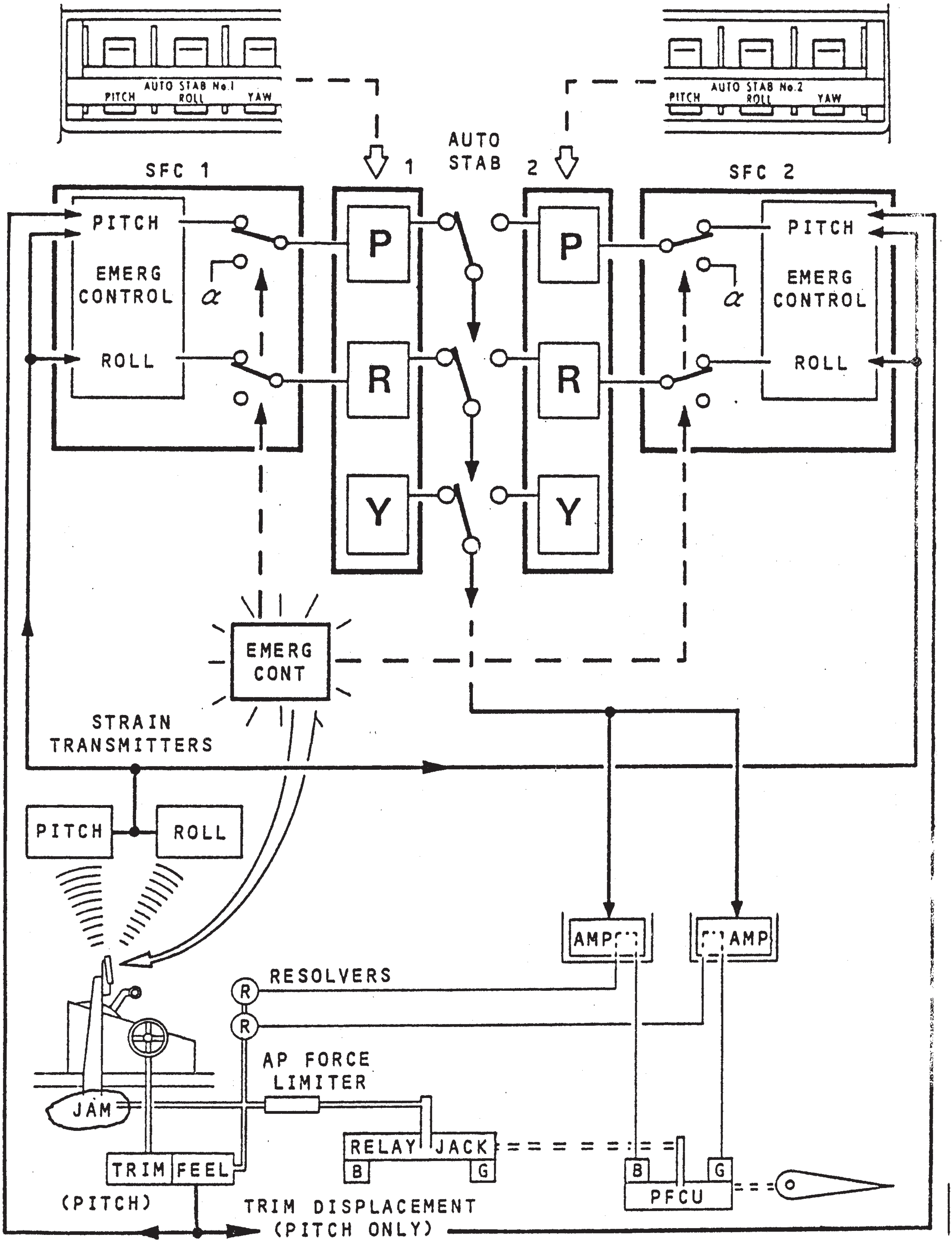


AUTO STABILIZATION SYSTEM



EMERGENCY FLIGHT CONTROL



SERVO CONTROLS PANEL (Sheet 1 of 3)

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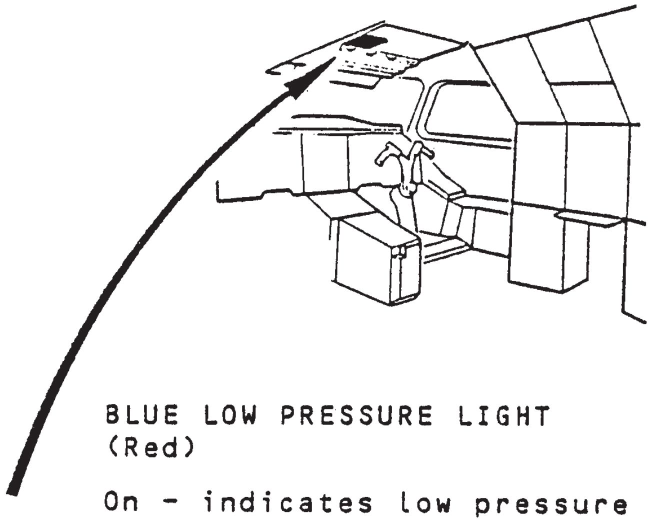
GREEN LOW PRESSURE LIGHT (Red)

On - indicates low pressure downstream of the green system PFC servos selector
or
if YELLOW_GREEN is selected low pressure downstream of the yellow/green PFC servos selector.
Accompanied by MWS PFC light (red) and audio (gong) except when MWS is inhibited.



BLUE LOW PRESSURE LIGHT (Red)

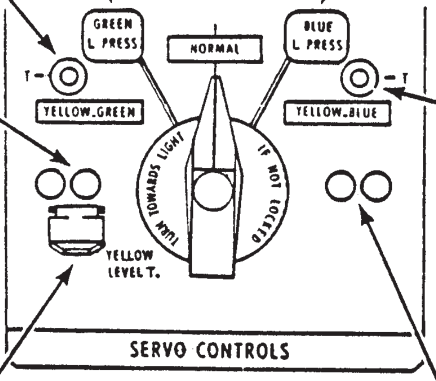
On - indicates low pressure downstream of the blue system PFC servos selector
or
if YELLOW_BLUE is selected low pressure downstream of the yellow/blue PFC servos selector.
Accompanied by MWS PFC light (red) and audio (gong).

GREEN L. PRESS TEST PUSH BUTTON

Pressed - tests the warning light and its connection to the master warning system.

YELLOW_GREEN PEA LIGHTS (Green)

On - to show both electrical controls of the YELLOW_GREEN system PFC selector are signalled to OPEN.



BLUE L.PRESS TEST PUSH BUTTON

Pressed - tests the warning light and its connection to the master warning system.

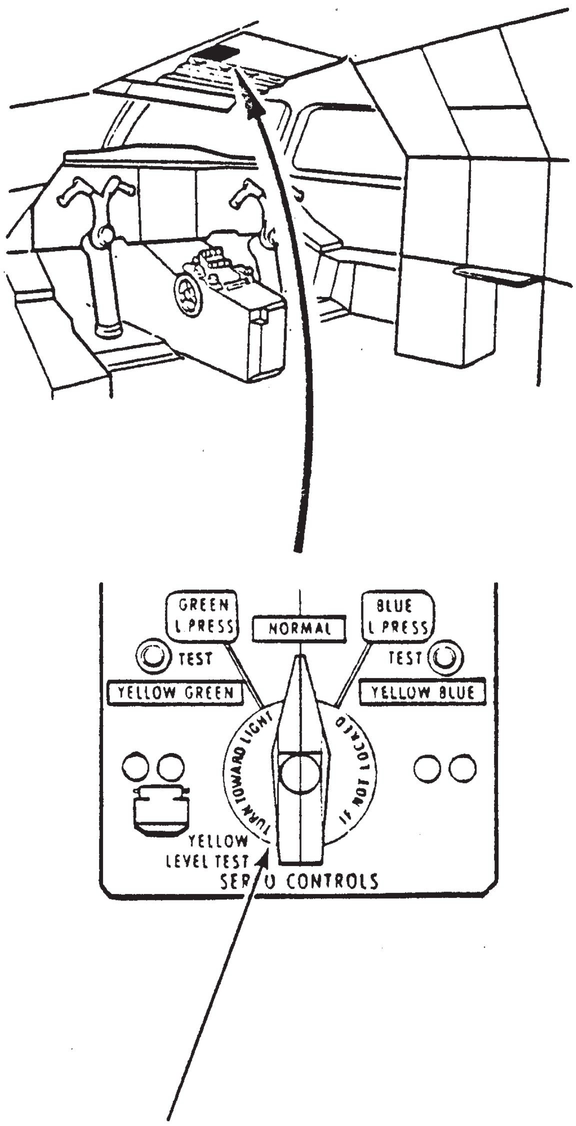
YELLOW LEVEL TEST PUSH BUTTON

Simulates the first low level condition in the hydraulic reservoir. Tests the control which, in the event of a yellow system fluid loss, automatically isolates the yellow system from the side of the PFC and relay jacks previously selected. Also tests the auto change of the yellow system to the unselected system in the event of low pressure in that system.

YELLOW_BLUE PEA LIGHTS (Green)

On - to show both electrical controls of the YELLOW_BLUE system PFC selector are signalled to OPEN.

SERVO CONTROLS PANEL (Sheet 2 of 3)



YELLOW (POWER FLIGHT CONTROL) ROTARY SELECTOR

NORMAL - the yellow hydraulic system is isolated from the flight controls hydraulic system.

NOTE: Movement of the yellow rotary selector away from NORMAL automatically onloads the yellow hydraulic system engine driven pumps (2).

YELLOW GREEN - the green hydraulic system selectors to the green side of the PFC servos and relay jacks are signalled to close and the yellow hydraulic system selectors to the green side of the PFC servos and relay jacks are signalled to open thus the yellow system powers the green ram of each power flight control servo (8) and relay jacks (3).

Because the normal brake system is tapped downstream of the power flight controls selectors the yellow system also powers the normal brake system.

YELLOW BLUE - the blue hydraulic system selectors (2) to the blue side of the PFC servos and relay jacks are signalled to close and the yellow hydraulic system selectors to the blue side of the PFC servos and relay jacks are signalled to open thus the yellow system powers the blue ram of each power flight control servo (8) and relay jacks (3).

(Unchanged)

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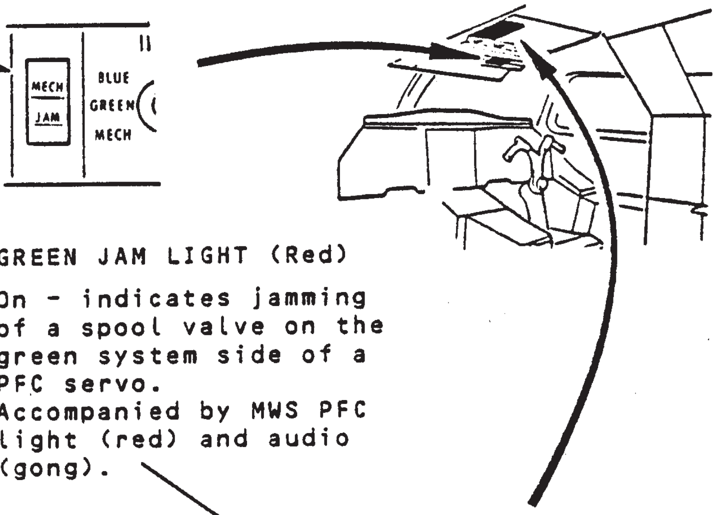
SERVO CONTROLS PANEL (Sheet 3 of 3)

MECHANICAL JAM LIGHT (Red)

On - indicates mechanical channel jamming downstream of the pitch or roll relay jack. Accompanied by MWS PFC light (red) and audio (gong).

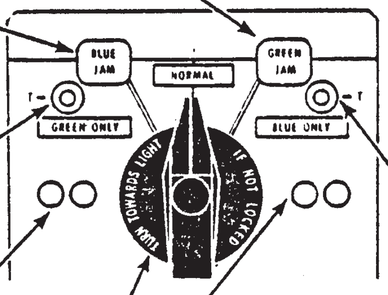


GREEN JAM LIGHT (Red)

On - indicates jamming of a spool valve on the green system side of a PFC servo. Accompanied by MWS PFC light (red) and audio (gong).

BLUE JAM LIGHT (Red)

On - indicates jamming of a spool valve on the blue system side of a PFC servo. Accompanied by MWS PFC light (red) and audio (gong).



BLUE JAM TEST PUSH BUTTON

Pressed - tests the warning light and its connection to the master warning system.

GREEN JAM TEST PUSH BUTTON

Pressed - tests the warning light and its connection to the master warning system.

GREEN ONLY PEA LIGHTS (Green)

On - to show that both electrical controls of the blue system PFC selectors are signalled to close.

BLUE ONLY PEA LIGHTS (Green)

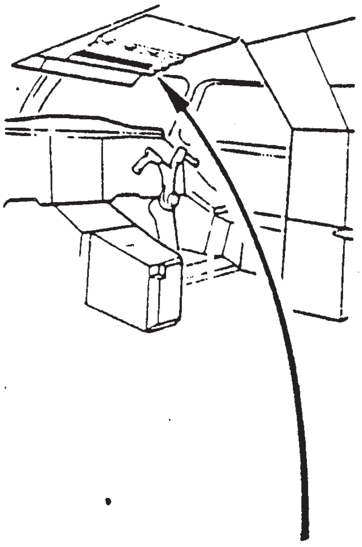
On - to show that both electrical controls of the green system PFC selectors are signalled to close.

SERVO CONTROLS BLACK ROTARY SELECTOR

NORMAL	- provided the yellow rotary selector is at NORMAL, blue hydraulic pressure is selected to supply the blue side of all PFC servos and green hydraulic pressure to supply the green side.
BLUE JAM GREEN ONLY	- signals both controls of the blue system PFC selectors to close, inhibits the BLUE JAM light, and arms the auto change system that selects yellow/green in the event of green low pressure.
GREEN JAM BLUE ONLY	- signals both controls of the green system PFC selectors to close, inhibits the GREEN JAM light, and arms the auto change system that selects yellow/blue in the event of blue low pressure.

NOTE: Inadvertent selection of crossed positions of the BLACK and YELLOW rotary selectors is prevented by a mechanical interlock.

INVERTERS AND ELECTRICAL CHANNELS

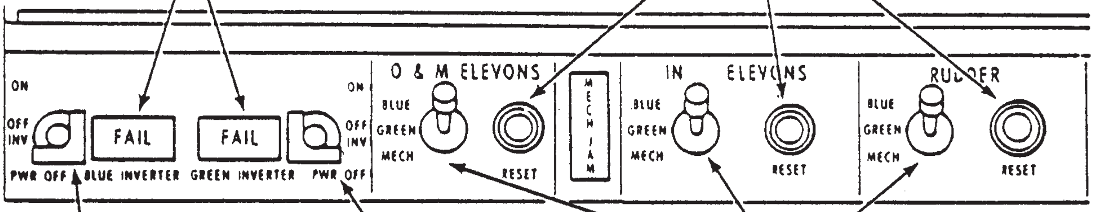


BLUE AND GREEN INVERTER FAIL LIGHT (Red)

On - indicates that the output from the inverter is outside limits and the d.c. supply has been cut. Accompanied by MWS PFC light (red) and audio (gong), and in some cases warning lights (red) on the flight controls position indicator.

RESET PUSH BUTTON

Pressed - acts from either green or mechanical and will attempt to regain the BLUE channel; if the monitoring system rejects the BLUE channel it will attempt to regain the GREEN channel and if this is rejected will revert to MECH channel.



OUTER AND MIDDLE ELEVONS, INNER ELEVONS AND RUDDER SELECTORS

BLUE - selects the blue electrical signalling channel as the primary operating channel for the flight controls.

NOTE: It is the only selection used in flight.

BLUE INVERTER SELECTOR

ON - provides a.c. power to the corresponding blue flight control electrical channel.

OFF INV - cuts the a.c. power to the corresponding blue flight control electrical channel. Inhibits the associated FAIL light.

PWR OFF - Cuts both the a.c. and d.c. power to the corresponding flight control electrical channel, the flight control monitoring system and, when the GREEN INVERTER selector is at PWR OFF, the flight control position indicator.

GREEN INVERTER SELECTOR

ON - connects the a.c. power to the corresponding green flight control electrical channel.

OFF INV - cuts the a.c. power to the corresponding green flight control electrical channel. Inhibits the associated FAIL light.

PWR OFF - cuts both the a.c. and d.c. power to the corresponding flight control electrical channel, the flight control monitoring system and, when the BLUE INVERTER selector is at PWR OFF, the flight control position indicator.

(Unchanged)

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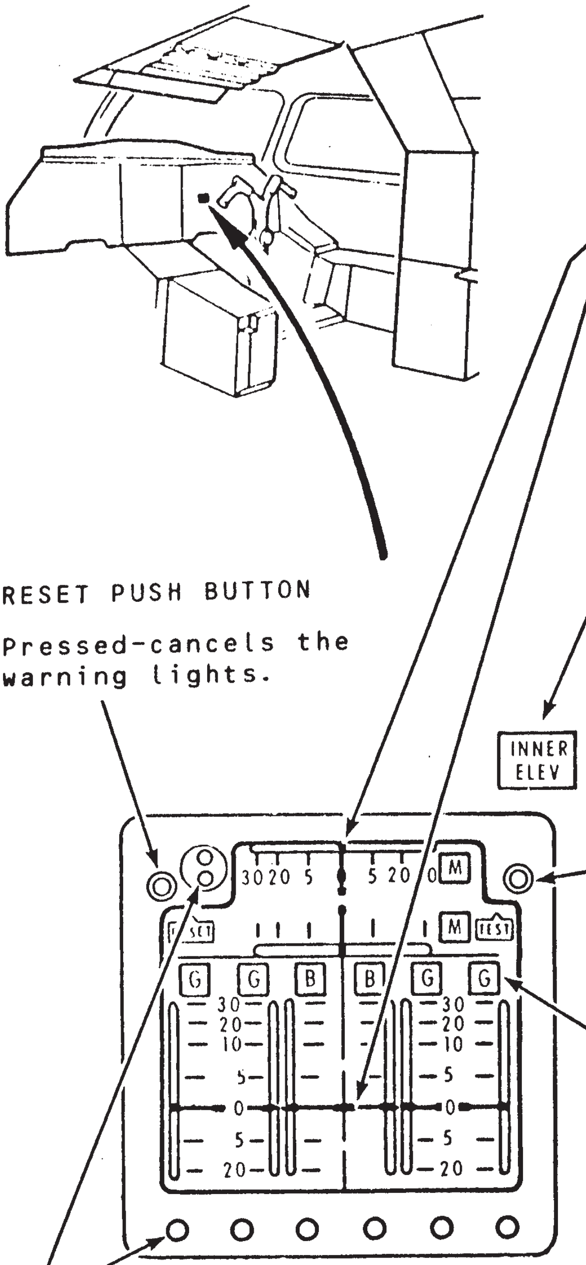
FLIGHT CONTROL POSITION INDICATOR



FLIGHT CONTROL POSITION INDICATOR

Rudders
Elevons

INNER ELEV LIGHT (Red)

On - indicates that the hinge moment caused by the aerodynamic load on one inner elevon exceeds the power of the servo controls.
or
that the blue and green spool valves on one servo control are not synchronised because of a linkage failure.
Accompanied by MWS PFC light (red) and audio (gong).

RESET PUSH BUTTON

Pressed-cancels the warning lights.

TEST PUSH BUTTON

Pressed - tests the warning lights and the flasher unit.
Released - tests the warning lights and their connection to the master warning system.

FLIGHT CONTROL CHANNEL MAGNETIC INDICATORS(8)

The flight control channel in use is displayed by one MI for each control surface.

M - mechanical channel

B - blue electrical channel

G - green electrical channel

WARNING LIGHTS (Red) (8)

On steady - indicate that on the corresponding flight control surface group, a channel changeover has been signalled by the comparator system. The lights remain on steady until an alarm RESET is made.
Accompanied by a master warning system PFC light (red) and audio (gong).

On symmetrical pair flashing-indicates an oscillation on one or both of the relevant control surfaces.

ANTI STALL SYSTEM PANEL

ANTI STALL SYSTEM SWITCHES

ON - Engages the anti high incidence system which comprises:

A super autostabilization system that augments the down elevon autostab signal when angle of attack reaches 13.5 degrees.

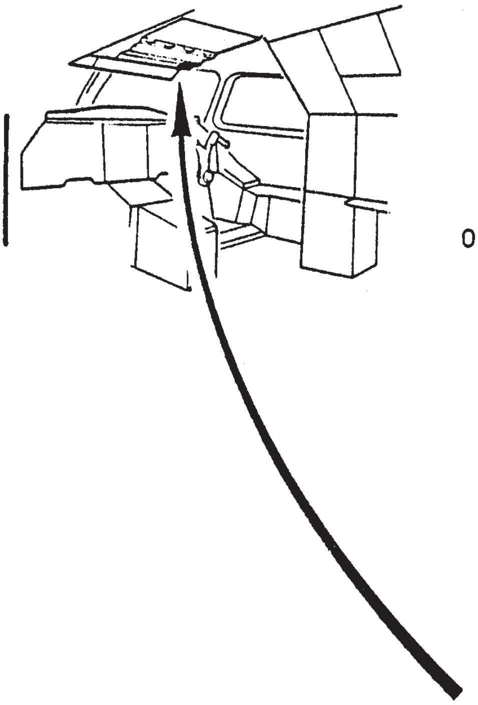
An unmistakable warning ie: a stick wobbler which pulsates the control column at 3 Hz if a nose up force is being applied and the aircraft angle of attack exceeds 19 degrees.

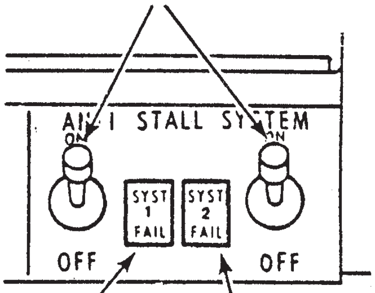
The system operates only below 60 knots on the ground and from about 10 seconds after lift off at speeds below 270 knots.

OFF - Disengages the anti high incidence system and, if the aircraft speed is below 270 knots, causes the disengagement of the associated pitch auto stabilisation channel.

NOTE:

With both anti stall system switches at OFF either one of the two auto stabilisation pitch axes can be re-engaged below 270 knots.





SYST 1 FAIL LIGHT (Amber)

On - at aircraft speeds above 270 knots indicates a power failure within the No. 1 anti stall system

On - at aircraft speeds below 270 knots indicates loss of No. 1 anti stall system or
loss of No. 1 pitch autostabilisation system.

SYST 2 FAIL LIGHT (Amber)

On - at aircraft speeds above 270 knots indicates a power failure within the No. 2 anti stall system

On - at aircraft speeds below 270 knots indicates loss of No. 2 anti stall system or
loss of No. 2 pitch autostabilisation system.

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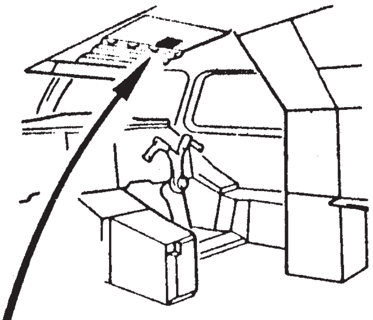
RELAY JACK PANEL

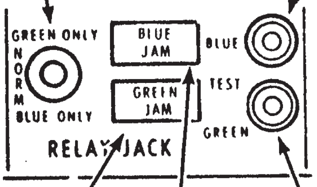
RELAY JACKS SELECTOR

GREEN ONLY - signals the relevant hydraulic selector for the blue side of the relay jack to close and inhibits the BLUE JAM light.

NORM - blue system hydraulic pressure is selected to supply the blue sides of the pitch, roll and yaw relay jacks and green system hydraulic pressure is selected to supply the green sides.

BLUE ONLY - signals the relevant hydraulic selector for the green side of the relay jack to close and inhibits the GREEN JAM light.





BLUE TEST PUSH BUTTON

Pressed - tests the BLUE JAM warning light and its connection to the master warning system.

GREEN TEST PUSH BUTTON

Pressed - tests the GREEN JAM warning light and its connection to the master warning system.

GREEN JAM LIGHT (Red)

On - indicates that the spool valve on the green side of the relay jack has jammed.

The jam detection automatically signals the relevant hydraulic selector to shut, accompanied by the MWS PFC (red).

Note: If No.2 autopilot is engaged it will disengage.

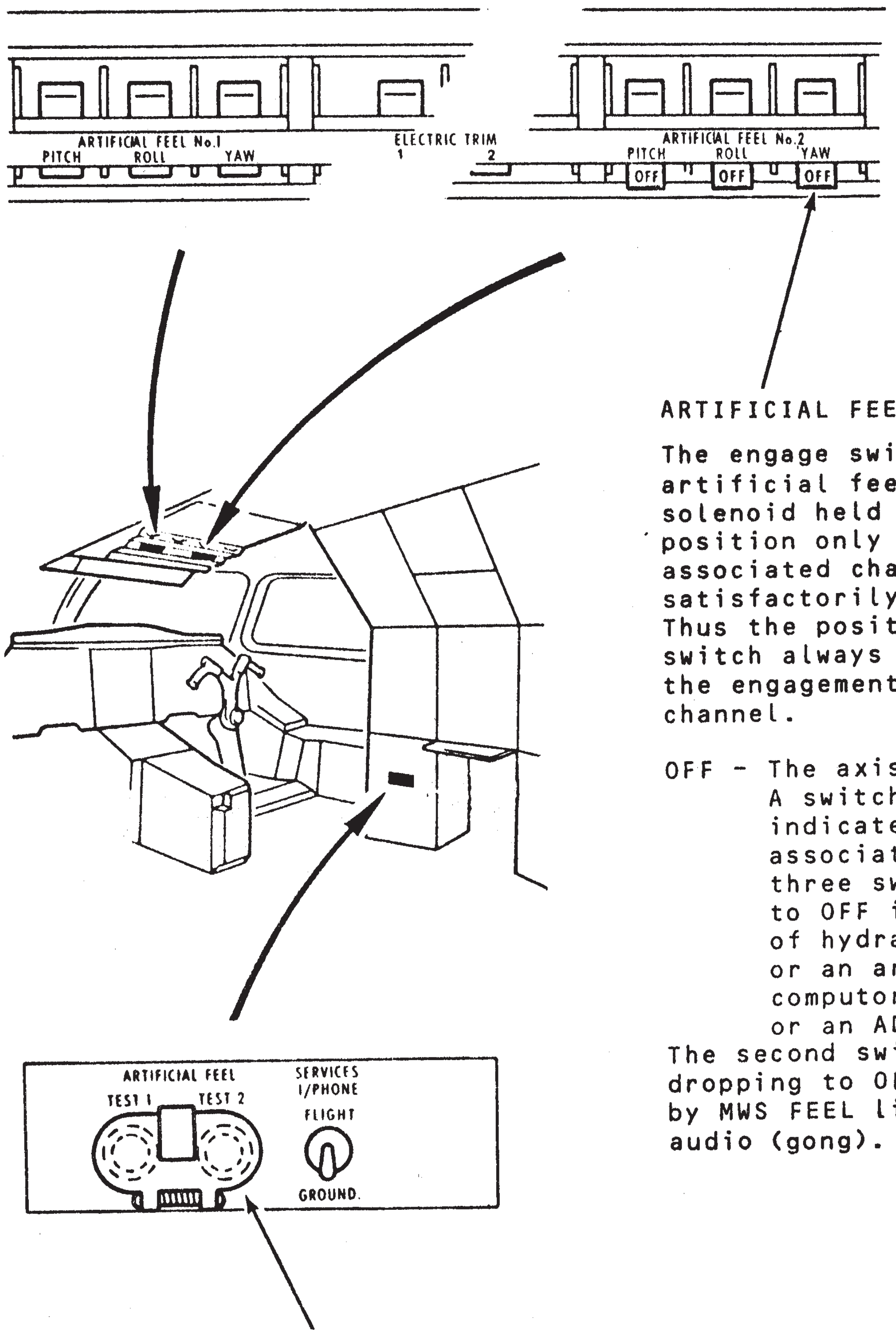
BLUE JAM LIGHT (Red)

On - indicates that the spool valve on the blue side of the relay jack has jammed

The jam detection automatically signals the relevant hydraulic selector to shut, accompanied by the MWS PFC (red).

Note: If No.1 autopilot is engaged it will disengage.

ARTIFICIAL FEEL



ARTIFICIAL FEEL SWITCHES

The engage switch for each artificial feel channel is solenoid held in the engage position only when the associated channel has been satisfactorily engaged. Thus the position of the switch always indicates the engagement state of the channel.

OFF - The axis is disengaged. A switch dropping to OFF indicates a loss of the associated jack, while three switches dropping to OFF indicate a loss of hydraulic pressure, or an artificial feel computor malfunction or an ADC malfunction.

The second switch of an axis dropping to OFF is accompanied by MWS FEEL light (red) and audio (gong).

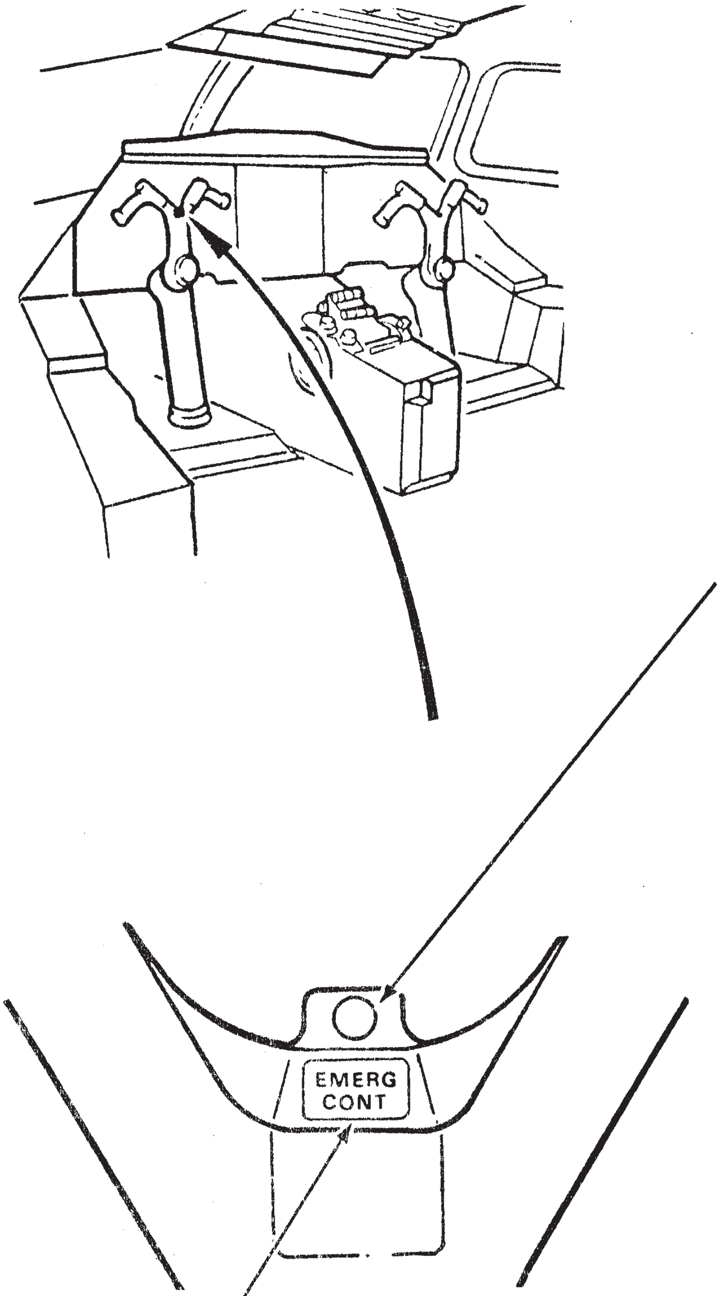
ARTIFICIAL FEEL TEST 1 AND TEST 2 PUSH BUTTON

TEST 1 pressed - tests by simulating an error signal, the artificial feel No.1 monitoring system and its connection to the master warning system.

TEST 2 pressed - identical for system 2.

(Unchanged)

EMERGENCY FLIGHT CONTROLS SYSTEM



EMERGENCY CONTROL TEST PUSH BUTTON

Pressed - with AUTO STAB No.1 engaged tests the emergency flight control system No.1; with AUTOSTAB No.2 engaged tests the emergency flight control system No.2

EMERGENCY CONTROL PUSH BUTTON LIGHT (Green)

Pressed - selects the emergency flight control system, used in case of control column/wheel jamming, EMERG CONT light (green) on indicates successful engagement.
Effective only if electrical flight control channel is engaged and pitch and roll auto-stabilization is engaged.
Pressed - when emergency flight controls engaged disconnects the system.

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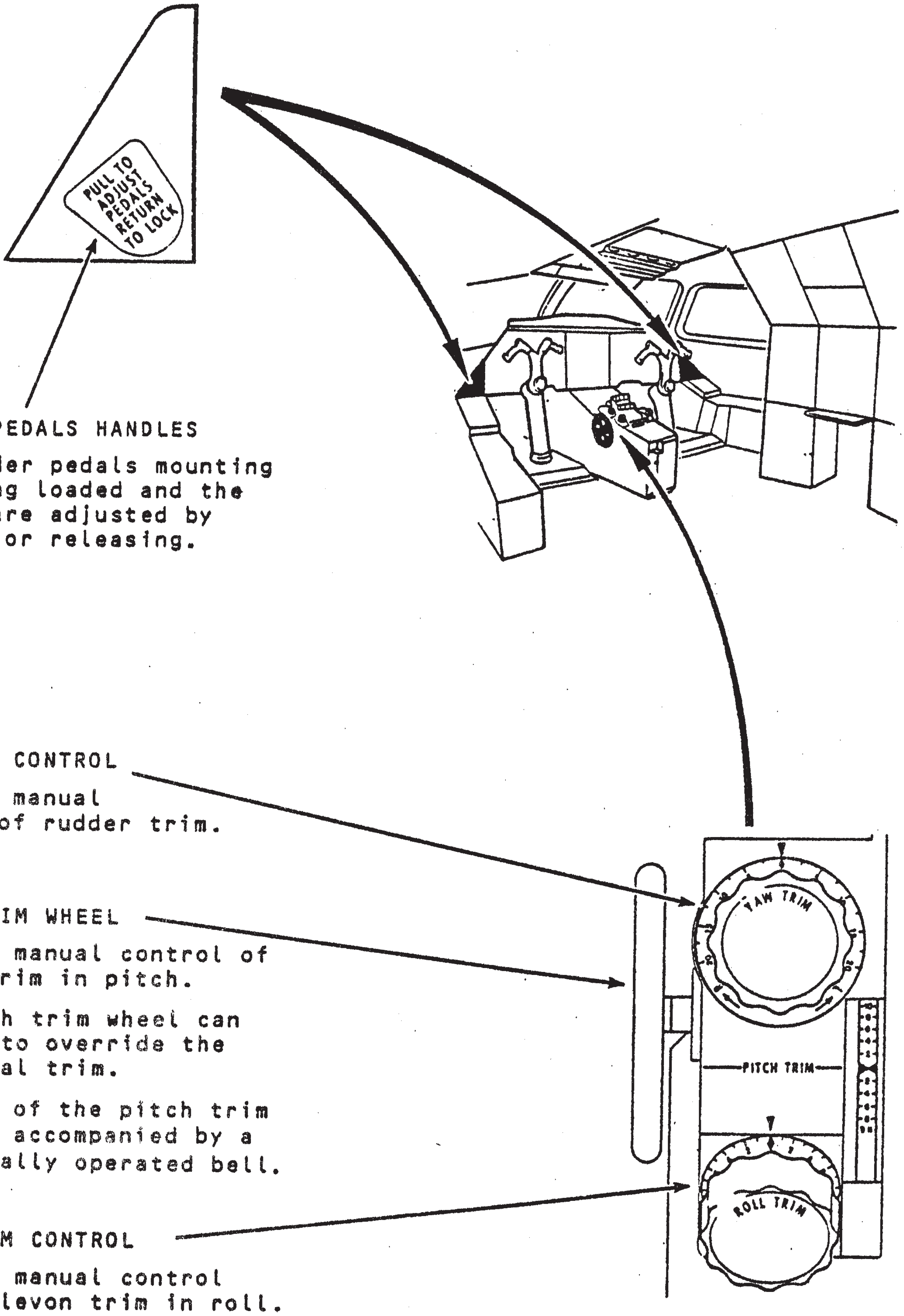
TRIM CONTROL AND RUDDER PEDAL ADJUSTMENT



ADJUST PEDALS HANDLES

The rudder pedals mounting is spring loaded and the pedals are adjusted by pushing or releasing.

YAW TRIM CONTROL

Provides manual control of rudder trim.

PITCH TRIM WHEEL

Provides manual control of elevon trim in pitch.

The pitch trim wheel can be used to override the electrical trim.

Movement of the pitch trim wheel is accompanied by a mechanically operated bell.

ROLL TRIM CONTROL

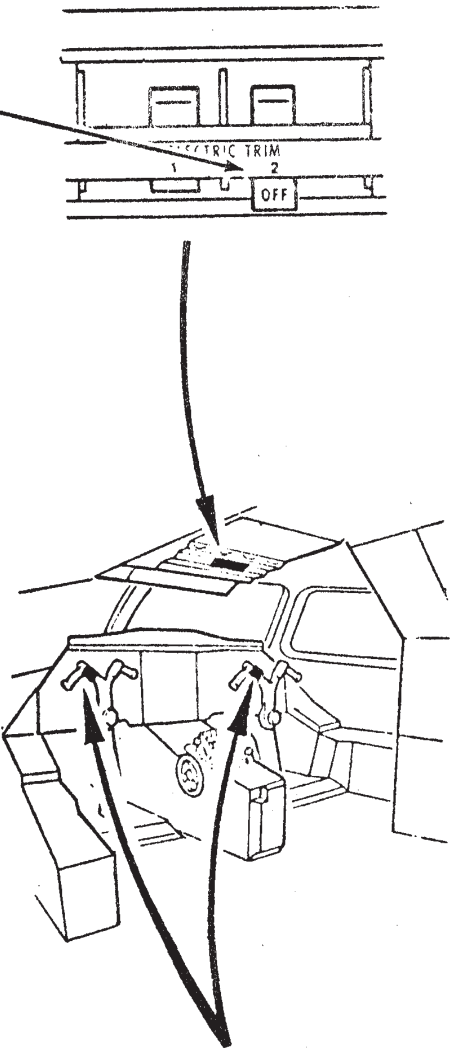
Provides manual control of all elevon trim in roll.

(Unchanged)

ELECTRIC TRIM CONTROL

ELECTRIC TRIM SWITCHES

The engage switch for each electric trim channel is solenoid held in the engage position only when the associated channel has been satisfactorily engaged Thus the position of the switch always indicates the engagement state of the channel.



OFF - The channel is disengaged. Failure of both electrical trim channels is accompanied by a MWS TRIM light (red) and audio (repeating gong) plus the disconnection of engaged autopilot channels and audio (cavalry charge). However, if the autopilots are engaged in LAND mode below 100 ft or in GO-AROUND they are not disconnected and the aircraft continues with fixed trim.

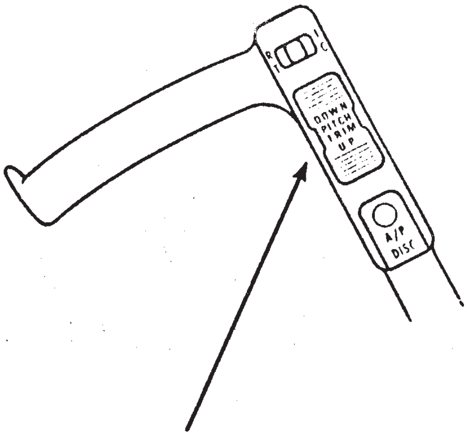
NOTE

Maximum pitch up deflection is approximately 15 deg. At this value the electric trim may automatically disengage and activate warnings (MWS TRIM light (red) and audio (gong).

NOTE

When the aircraft is on the ground with the main landing gear shock absorbers fully compressed and at least one throttle fully forward the electric trim will disengage if the trim deflection is greater than one degree up or three and a half degrees down. The monitoring remains operative for 10 seconds after lift off.

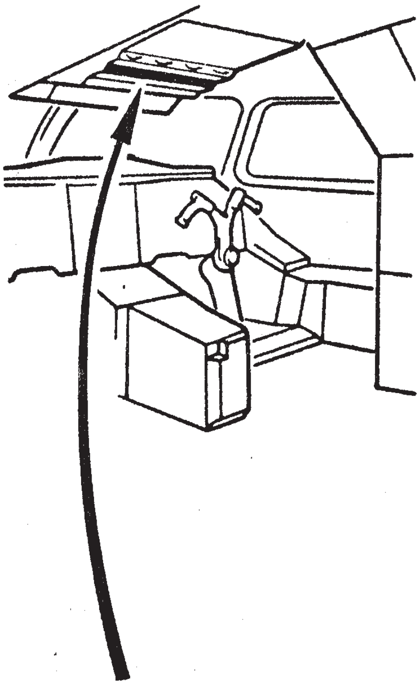
NOTE: At touch down the monitoring is inhibited for 30 seconds thus avoiding any untimely trim disconnection during touch and go manoeuvres.



PITCH TRIM CONTROL SWITCH

Both control columns have a PITCH TRIM selector that is spring loaded to the centre position.

AUTOSTAB SWITCHES

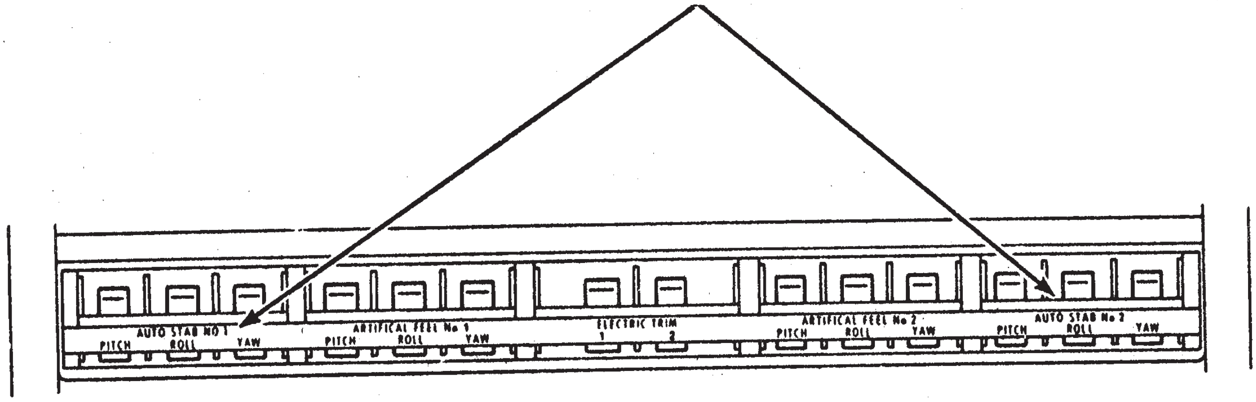


AUTO-STAB PITCH-ROLL-YAW SWITCHES

The engage switch for each AUTO-STAB channel is solenoid held in the engage position only when the associated channel has been satisfactorily engaged. Thus the position of the switch always indicates the engagement state of the channel.

OFF - The axis is disengaged Accompanied by disconnection of the associated autopilot and flight director HOWEVER if the GO AROUND mode is engaged the flight director will not disconnect.

Failure of both autostabilisation channels is accompanied by a MWS STAB Light (red) and audio (repeating gong)



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Chapter 10

FLIGHT INSTRUMENTS

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Controls and Indicators

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Standby Horizon 10.02.06
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Flight Engineers Flight Instruments 10.02.13
Clock 10.02.14

FLIGHT INSTRUMENTS

GENERAL

This chapter includes those basic instruments and standby instruments which provide altitude, airspeed, mach number, attitude, true airspeed, vertical speed, side slip, temperature and time information to the crew. The aircraft integrated data system (AIDS) records and stores selected flight parameters. The radiation detection and warning system indicates and monitors the level of cosmic radiation.

FLIGHT INSTRUMENTS

The source of data for the flight instruments are the ADCs.

ADC 1 supplies the Captain's	ASI	) Normal mode
	Altimeter	)
	Machmeter	
	Temperature Indicator	
	Vertical Speed Indicator	
	Incidence Indicator	
Flight Engineer's	Machmeter	
ADC 2 supplies the First Officer's	ASI	) Normal mode
	Altimeter	)
	Machmeter	
	Temperature Indicator	
	Vertical Speed Indicator	
	Incidence Indicator	
Flight Engineer's	Altimeter	

The ADC "servoed" channels have internal monitoring and cross comparison, ADC 1 - ADC 2, circuits which trigger the M.W.S. and cause instrument failure warning flags to appear if the thresholds are exceeded. If an A.D.C. is switched OFF, the instrument displays will remain fixed.

The Captain's and First Officer's A.S.I. and Altimeter in their "Standby" mode of operation are supplied with pitot and static pressures from the nose probe and an independent electrical power supply. The combined Standby ASI/Machmeter and the Standby Altimeter are supplied with pitot/static and static pressure respectively from the nose probe. They are both direct sensing pressure instruments.

Two side-slip angle (β) sensors located along the main fuselage centre-line Fwd & Aft, supply signals to the Captain's and First Officer's instruments respectively.

A second signal from the No 2 Total Temperature probe provides the necessary data to operate the flight engineer's Total Temperature Indicator independently of ADC No 2.

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AIRCRAFT INTEGRATED DATA SYSTEM (AIDS)

The PVS 1580 AIDS System comprises,
- a keyboard type Data Management and Entry Panel (DMEP)
- 2 Acquisition Units
- a Long Term Recorder
- an Accident Data Recorder with integral underwater location beacon.

The system has a limit exceedance programme for engine parameters N_1, N_2, and EGT. Should a limit be exceeded the green LIMIT light will illuminate which, when pressed, will display the parameter code and the value of the exceedance e.g. an N_1 2% above limit will show as 2.0.

Peak positive and negative 'g' values, in flight or on landing, can be displayed in absolute 'g' terms.

Maximum brake application speed in knots can be displayed.

CLOCK

The Air Precision clock has 3 LED presentations,
- GMT with tendency indicators
- Elapsed Time with Run/Stop/Reset control
- Chrono (timing facility)

The latter function operates in either Timer mode or conventional stop clock mode.

In timer mode, the throttle time will be preset in the display and manually started at the appropriate time. The preset time will then count down to zero.

In Stop Clock mode, the display is controlled by a Start/Stop/Reset control.

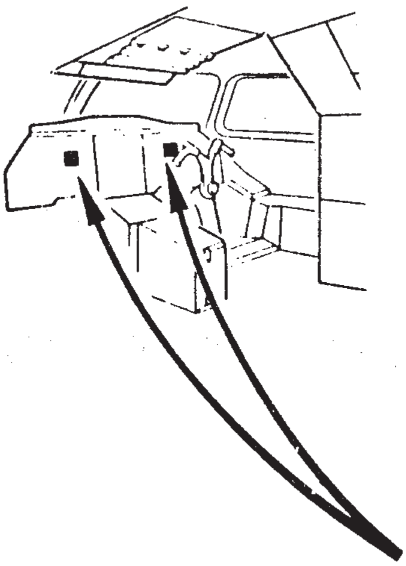
RADIATION METER

Supersonic transport aircraft fly higher than present aircraft and as a result get only a third of the atmosphere shielding from radiation. Consequently there is a possibility that higher levels of radiation than those encountered by current subsonic jets will be experienced.

Regulations require the radiation dose received by both passengers and crew to be limited. Hence a radiation detector sensitive to both ionising and neutron radiation detects both galactic and solar radiation and displays the combined total on a meter.

(Unchanged)

ALTIMETER



WARNING FLAG

A pointer/counter flag, red with black stripes, across the digits, together with the less than 10000 ft digit flag indicates:
- When the mode switch is set at N:
  loss of ADC validity signal.
  loss of normal mode power supply.
  loss of ADC altitude signal
  slaving error.
- When the mode is set at S:
  loss of standby mode power supply.
  slaving error.

A yellow and white striped flag appearing in lieu of the 10000 ft digit indicates that the altitude is negative.
In this case the digital reading is no more available.

BUGS

Set reminder bugs (4) White, yellow, red and green.

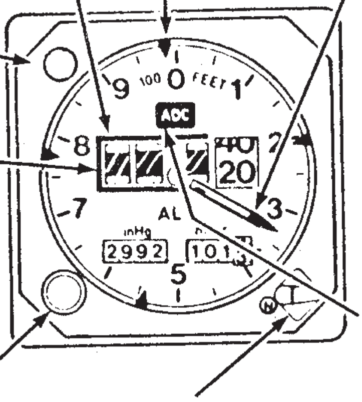
ALTITUDE ALERT LIGHT (Amber)

On - steady indicates approach to the altitude selected on the autopilot ALTITUDE SELECT.

On - flashing indicates deviation from the altitude selected on the autopilot ALTITUDE SELECT.

ALTITUDE POINTER

Indicates altitude in hundreds of feet.



WINDOW

The altitude information appears in digital form, in a window in the centre of the instrument. The altitude information (hundreds of feet) is shown by a pointer. The left part of the window displaying flight levels is outlined with a white line.

ADC - normal
STBY - standby

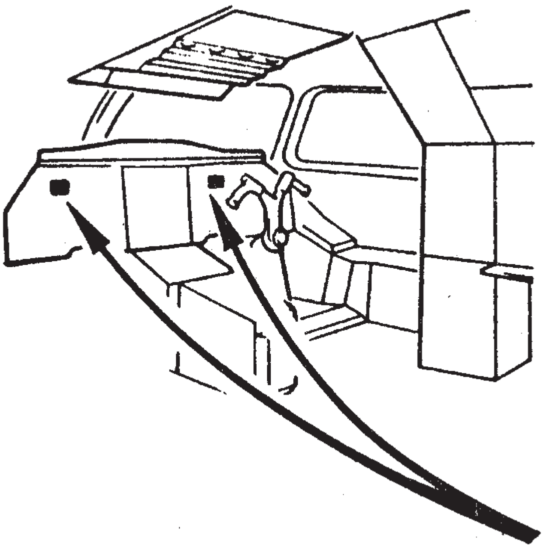
MODE SWITCH

A triangular switch which shows the mode selected by leaving N (normal) white on black background or S (standby) black on orange background visible.
The altimeter receives information directly from the nose probe; operation in the STBY mode will therefore require reference to position error corrections.

DATUM PRESSURE SETTING KNOB

Used to set the datum pressure displayed in two windows marked inHg and mbar.
Rotate static pressure knob to set the required setting in corresponding windows.

AIR SPEED INDICATOR (Sheet 1 of 2)



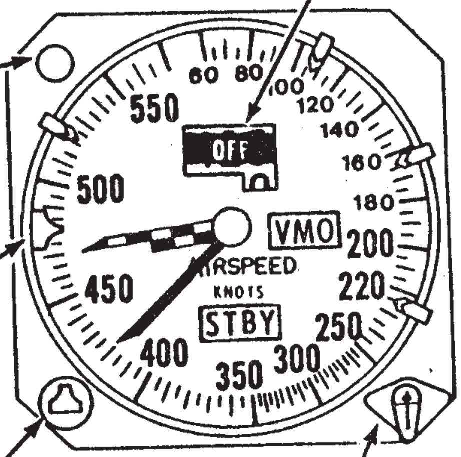
FAILURE FLAG (OFF)

Covering the speed digits, indicates:
When the mode switch is set at N:
- loss of ADC Validity signal.
- loss of normal mode power supply.
- loss of ADC speed signal.
- slaving error.

Also appears on both airspeed indicators if a discrepency is sensed between ADCs' outputs airspeed signals.
When the mode switch is set at S:
- loss of standby mode power supply
- slaving error.

LIGHT (Amber)

On - indicates a discrepancy between aircraft speed and speed selected on autothrottle.



ORANGE T-SHAPED REMINDER BUG

KNOB

To set the orange T-shaped reminder bug.

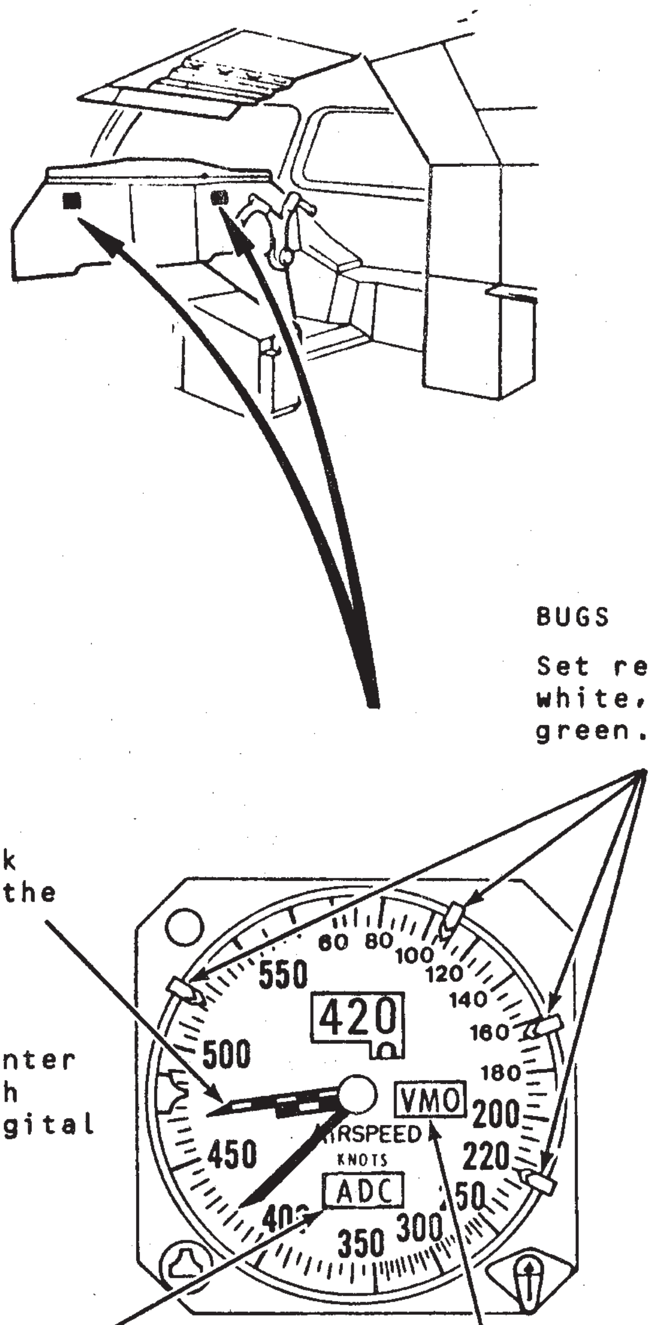
ASI MODE SWITCH

It is triangular-shaped and shows mode selected by leaving N (normal) in white on a black background or S (standby) in black on an orange background circle visible.

N mode - the ASI receives information through the appropriate ADC.

STBY mode - the ASI receives information directly from the nose probe; operation in the STBY mode will therefore require reference to position error corrections.

AIR SPEED INDICATOR (Sheet 2 of 2)



BUGS

Set reminder bugs (4) white, yellow, red and green.

Two pointers show speed information:

MAX SPEED POINTER

An orange and black pointer indicates the limiting value of M_{MO}, V_{MO} or T_{MO}.

CAS POINTER

A white narrow pointer indicates CAS which also appears in digital form.

ASI MODE FLAG

The selected mode is also shown on the ASI mode flag reading ADC (normal) printed white on a black background or STBY printed black on an orange background.

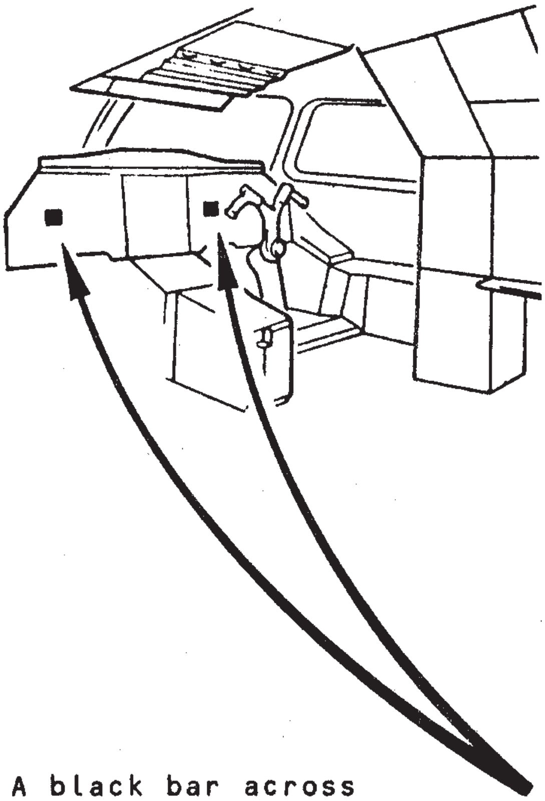
RED FLAG

With V_{MO} painted in black referring only to the limit pointer, indicates regardless of the operating mode:

- loss of ADC validity signal.
- loss of power supply.
- slaving error.

NOTE: Loss of power supply or slaving error has no effect on the operation of accuracy of the V_{MO} audio warning.

MACHMETER



Two pointers show Mach number information:

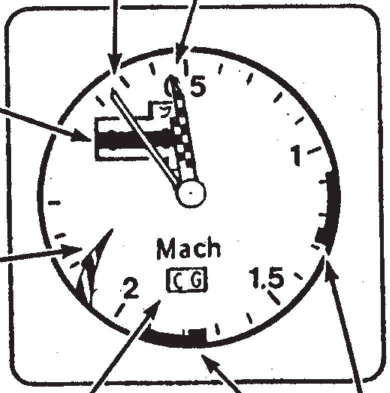
MACH No. POINTER

A white narrow pointer indicates the Mach number which also appears in digital form.

MAX MACH POINTER

An orange and black pointer indicates the limiting value of M_{MO}, V_{MO} and T_{MO}.

A black bar across counter when Mach number less than 0.45



FAILURE FLAG

A red and black striped arrow-shaped flag, indicates:
- loss of ADC validity signal.
- loss of Mach instrument power supply.
- slaving error.

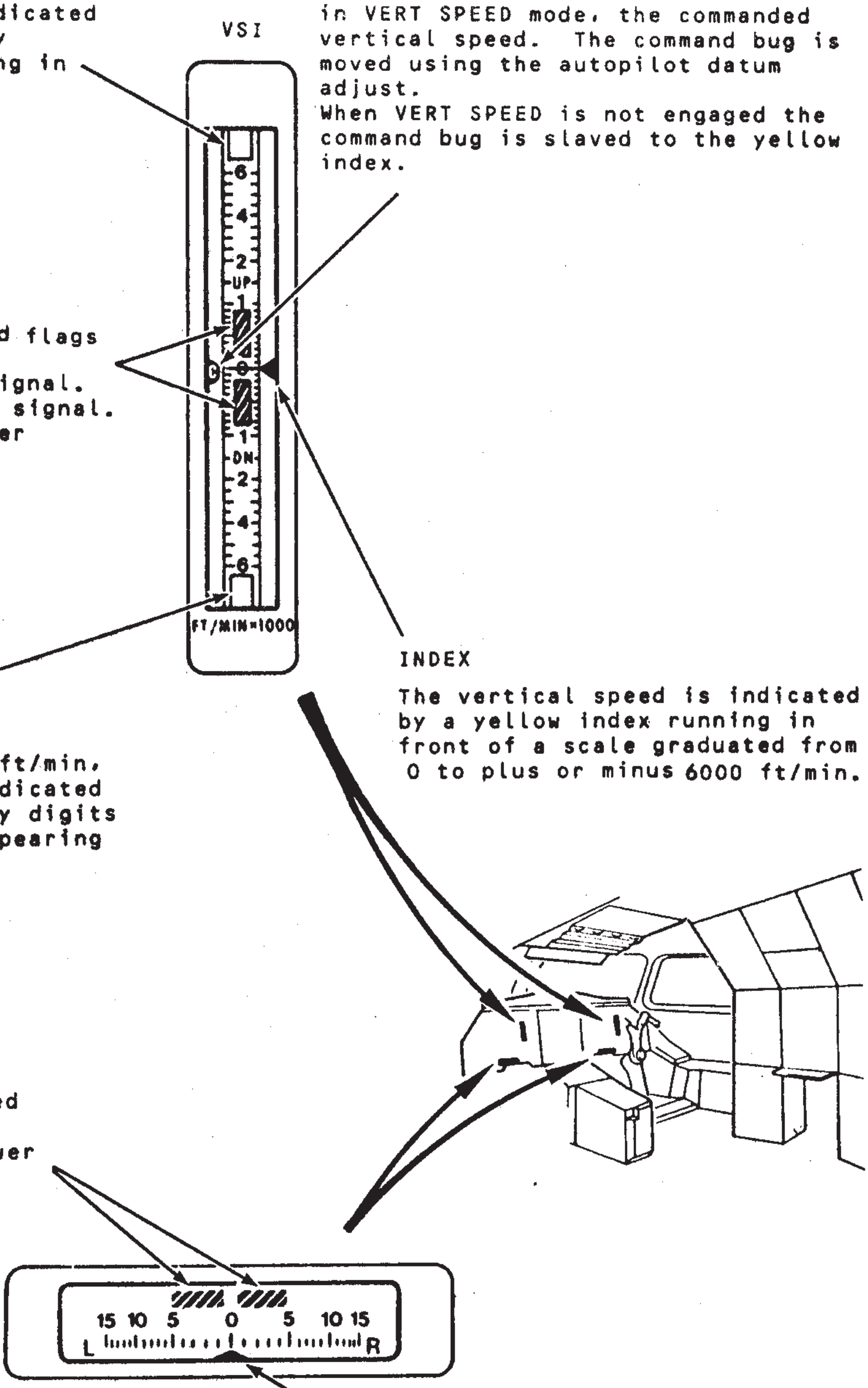
INDICES

Two orange indices with AFT and FWD respectively printed in black, controlled by the centre of gravity computer, indicate the maximum and minimum allowed Mach number according to the centre of gravity.

C.G. WARNING FLAG

A red flag with letters CG printed in black indicates:
- loss of centre of gravity validity signal.
- loss of Mach instrument power supply.
- slaving error
- loss of FWD and AFT limits bugs.

VERTICAL SPEED INDICATOR AND SIDESLIP INDICATOR



UPPER WINDOW

In excess of plus 6000 ft/min, the vertical speed is indicated in thousands of ft/min by digits 8,9 or 10 appearing in a window.

COMMAND BUG

A bug marked C shows, with the AFCS in VERT SPEED mode, the commanded vertical speed. The command bug is moved using the autopilot datum adjust.
When VERT SPEED is not engaged the command bug is slaved to the yellow index.

ALARM FLAGS

Two red and black striped flags indicate:
- loss of ADC validity signal.
- loss of vertical speed signal.
- loss of instrument power supply.
- slaving error.

INDEX

The vertical speed is indicated by a yellow index running in front of a scale graduated from 0 to plus or minus 6000 ft/min.

LOWER WINDOW

In excess of minus 6000 ft/min, the vertical speed is indicated in thousands of ft/min by digits 8,9,10,15,20,25 or 30 appearing in a window.

FAILURE FLAGS

Two red and black striped flags indicate:
- loss of instrument power supply.
- slaving error.

SIDESLIP INDICATOR

A white index indicates aircraft side slip angle in degrees directly from a sideslip vane.

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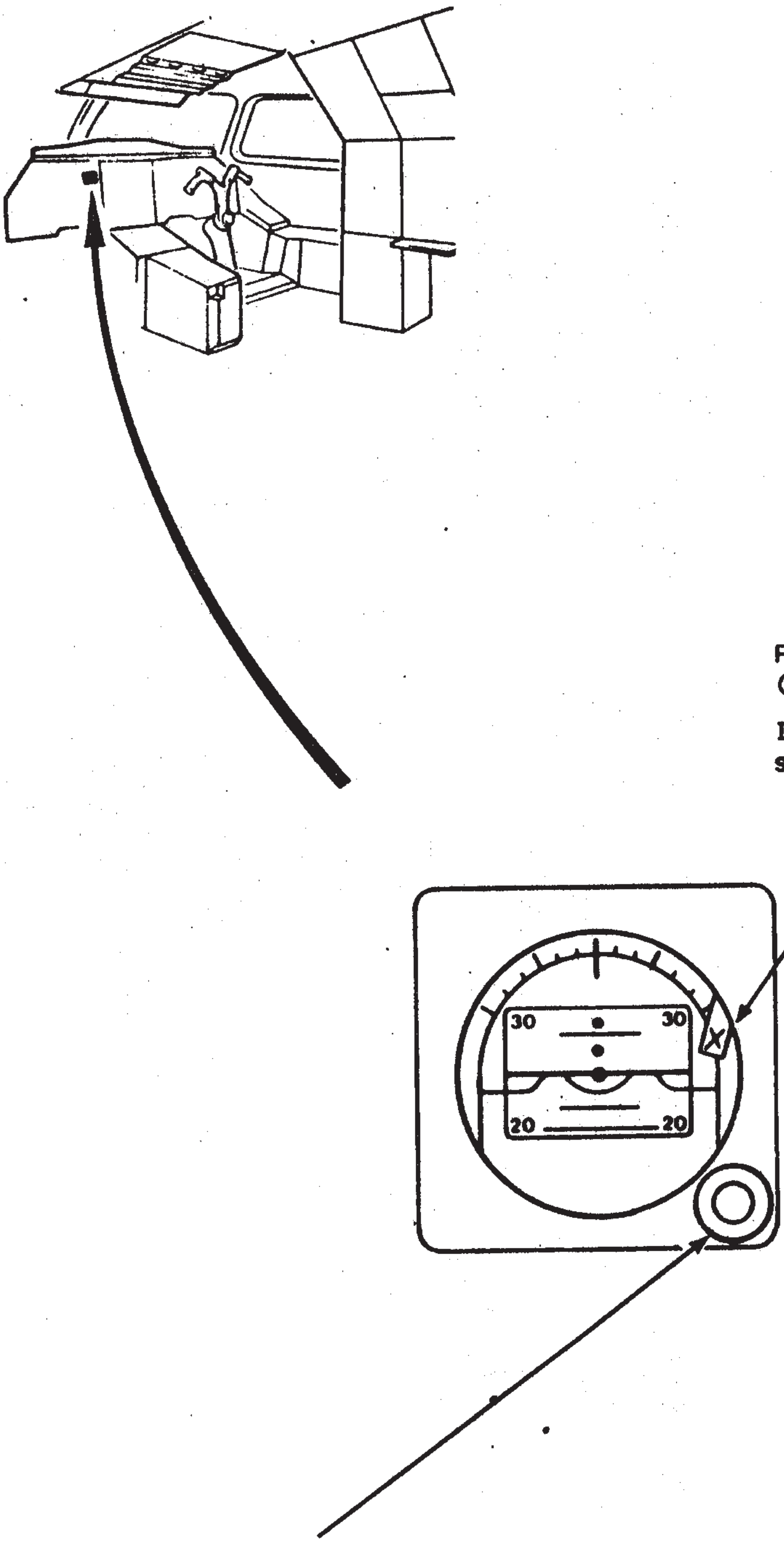
STANDBY HORIZON



FAILURE FLAG
(Red - White cross)

Indicates loss of power supply to the instrument.

STANDBY HORIZON

Is supplied from a DC essential busbar through a static inverter.

STANDBY HORIZON KNOB

Quick caging is obtained by pulling the knob slowly.

NOTE: The aircraft reference symbol is non-adjustable.

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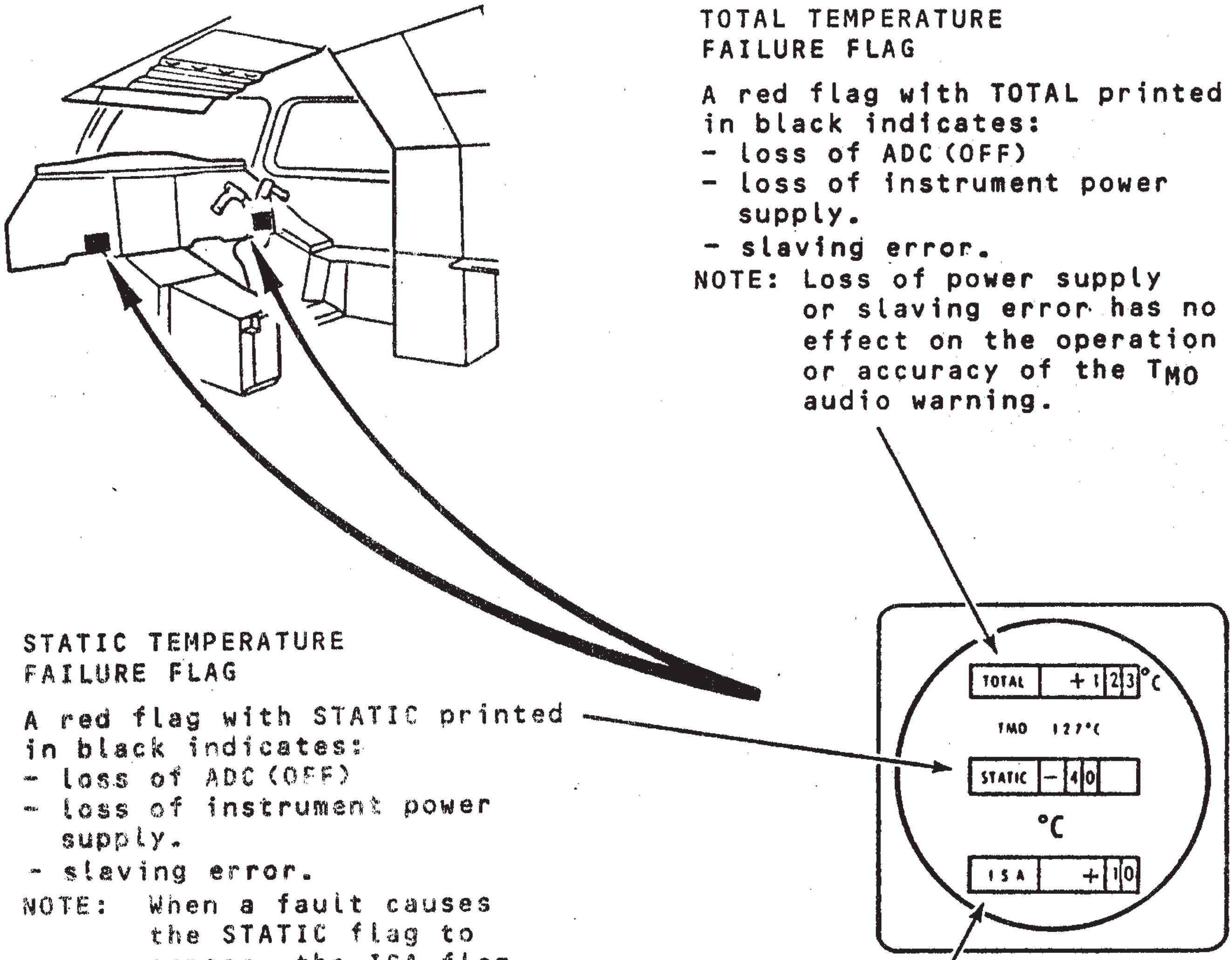
TEMPERATURE INDICATOR



TOTAL TEMPERATURE FAILURE FLAG

A red flag with TOTAL printed in black indicates:

- loss of ADC (OFF)
- loss of instrument power supply.
- slaving error.

NOTE: Loss of power supply or slaving error has no effect on the operation or accuracy of the T_{MO} audio warning.

STATIC TEMPERATURE FAILURE FLAG

A red flag with STATIC printed in black indicates:

- loss of ADC (OFF)
- loss of instrument power supply.
- slaving error.

NOTE: When a fault causes the STATIC flag to appear, the ISA flag will appear at the same time.

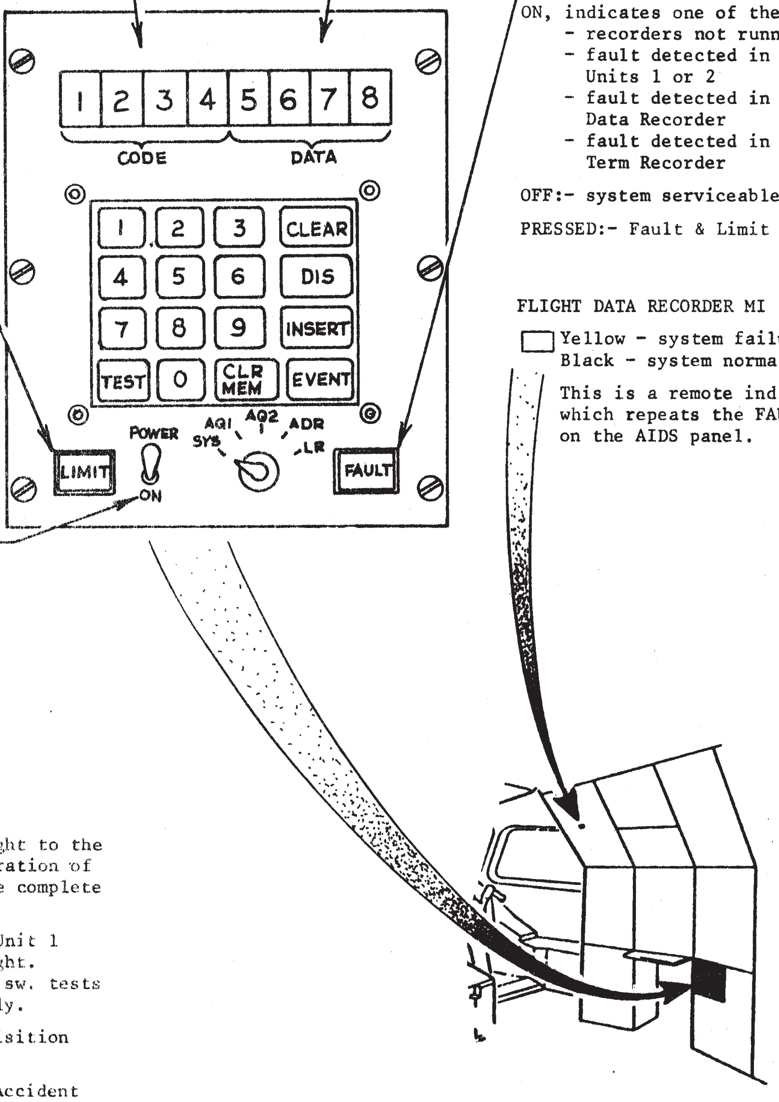
TEMPERATURE IN RELATION TO ISA FAILURE FLAG

A red flag with ISA printed in black indicates:

- loss of instrument power supply.
- altitude information slaving error.
- slaving error.
- static temp slaving error.

(Unchanged)

AIRCRAFT INTEGRATED DATA SYSTEM



CODE DISPLAY

displays - inserted data address code when inserting date or when calling up parameter readouts.

- data code associated with parameter exceedance when LIMIT key pressed.

DATA DISPLAY

displays inserted or recalled data.

LIMIT KEY/LIGHT (GREEN)

will illuminate for,

- an N_2 exceedance of more then 1.5%
- an N_1 exceedance of more than 1.5% below M 1.6 only
- an EGT exceedance of more than 15°C between 84% and 101.5% N_1 only.

Press the key to cancel the light and display the exceedance in the data display and the parameter code in the code display.
If the key remains illuminated repeat the above procedure as required.

FAULT KEY/LIGHT (AMBER)

ON, indicates one of the following,
- recorders not running
- fault detected in Acquisition Units 1 or 2
- fault detected in Accident Data Recorder
- fault detected in Long Term Recorder

OFF:- system serviceable.

PRESSED:- Fault & Limit lights.

FLIGHT DATA RECORDER MI

☐ Yellow - system failure
Black - system normal

This is a remote indicator which repeats the FAULT light on the AIDS panel.

TEST SWITCH

POWER:- spring loaded to this position. Recorders do not run when ground services bus live.

ON:- overrides ground power cut out to permit system test.

FAULT IDENT SELECTOR

SYS:- connects the FAULT light to the complete system. Operation of the Test sw. tests the complete system.

AQ1:- connects Acquisition Unit 1 only, to the FAULT light. Operation of the Test sw. tests Acquisition Unit 1 only.

AQ2:- as above but for Acquisition Unit 2.

ADR:- as above but for the Accident Data Recorder

LR:- as above but for the Long Term Recorder.

AIRCRAFT INTEGRATED DATA SYSTEM

All keys described on this page are white.

CLEAR KEY

Press to clear unwanted or erroneous information from the displays.

DISPLAY DATA KEY

Press to recall data.

After insertion of the appropriate code, the DIS key is pressed to display.

- max brake application speed.
- N_1, N_2 or EGT exceedance
- peak positive 'g' values in flight or landing.
- peak negative 'g' values in flight or landing.

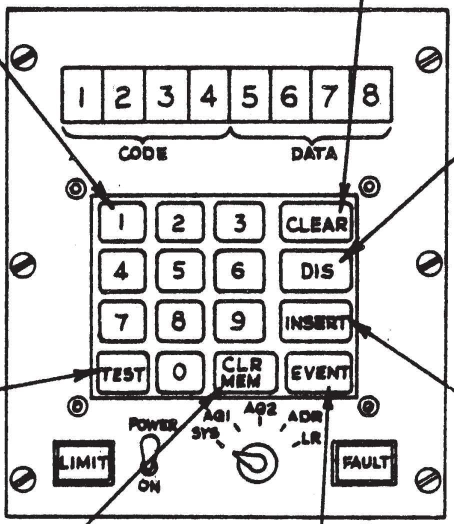
NOTE: "In flight" is defined as flight with gear locked up.

"Landing" is defined as flight with gear locked down.

Other parameters are displayed in Binary form.

KEYS 0 to 9

Used for code and data insertion



TEST KEY

Not used

INSERT KEY

Press to insert data shown in the displays

CLEAR MEMORY KEY

When pressed, will clear all data from the memory, i.e. all data that would have been available for recall & display.

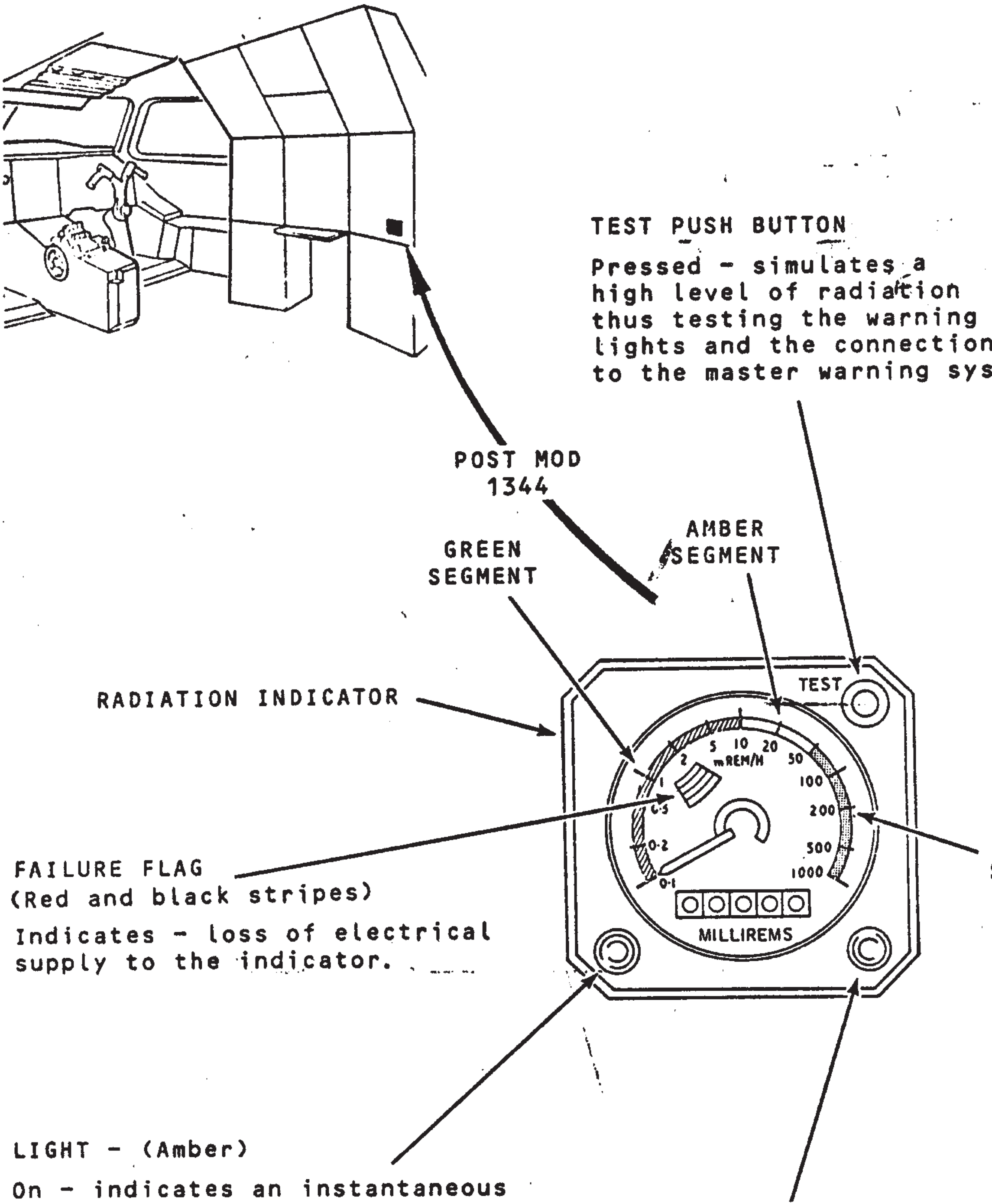
This facility is only available when the MWS DOORS circuit is activated i.e. a door or hatch open.

EVENT MARKER

Press to insert an event mark on to the recording

(Compeltely Revised)

RADIATION METER



TEST PUSH BUTTON

Pressed - simulates a high level of radiation thus testing the warning lights and the connection to the master warning system.

FAILURE FLAG
(Red and black stripes)

Indicates - loss of electrical supply to the indicator.

LIGHT - (Amber)

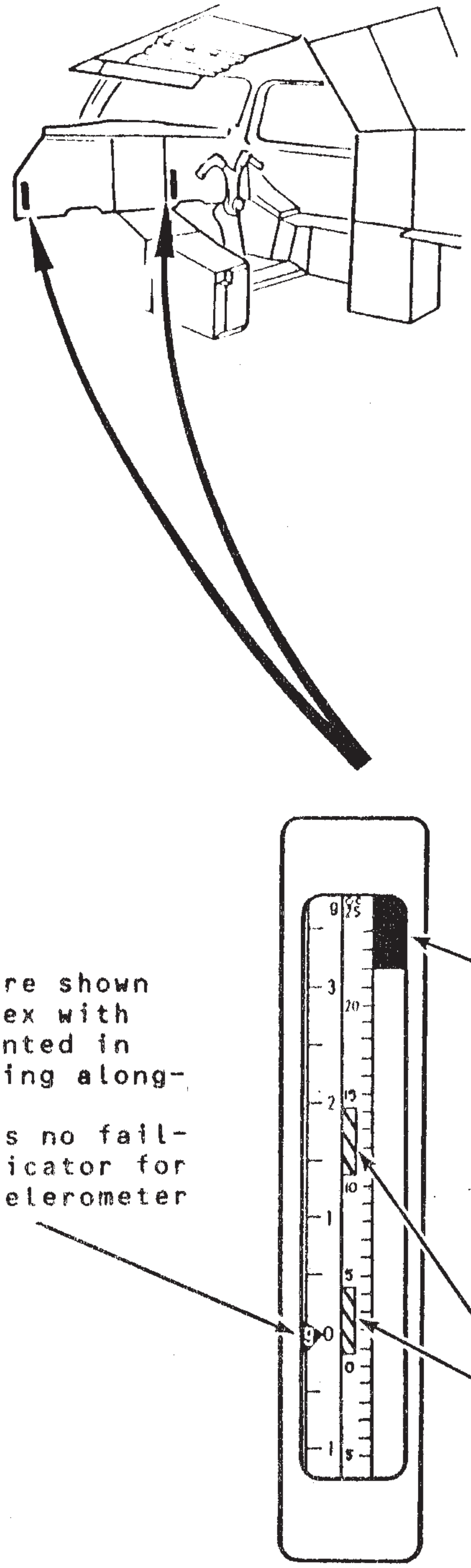
On - indicates an instantaneous radiation level of 10 to 50 mrem/hour.

LIGHT - (Red)

On - indicates an instantaneous radiation level greater than 50 mrem/hour
Accompanied by a MWS RADN light (red) and audio (gong).

(Unchanged)

ACCELEROMETER/ANGLE OF ATTACK INDICATOR



ACCELEROMETER MOVING INDEX

The g values are shown by a black index with a letter g printed in white and running alongside a scale.

NOTE: There is no failure indicator for the accelerometer

ANGLE OF ATTACK MOVING TAPE

The angle of attack value is indicated by a white tape running in front of a scale.

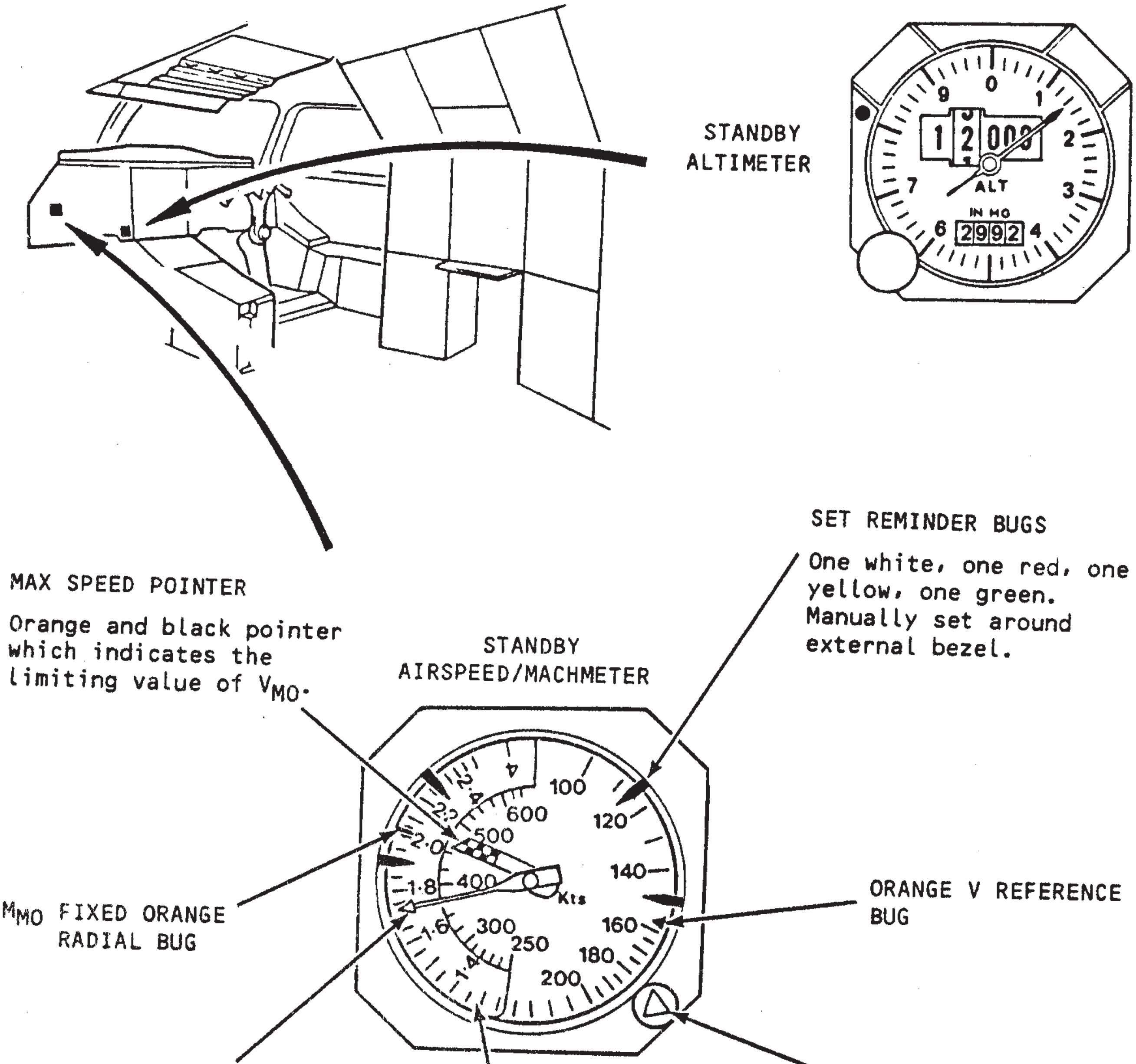
ANGLE OF ATTACK FAILURE FLAG

Two red and black striped flags indicate:

- loss of ADC signal
- loss of instrument power supply.
- loss of ADC synchro transmitter power supply.

(Unchanged)

STANDBY AIR SPEED INDICATOR/MACHMETER AND STANDBY ALTIMETER



STANDBY ALTIMETER

STANDBY AIRSPEED/MACHMETER

SET REMINDER BUGS

One white, one red, one yellow, one green. Manually set around external bezel.

MAX SPEED POINTER

Orange and black pointer which indicates the limiting value of V_{MO}.

M_{MO} FIXED ORANGE RADIAL BUG

ORANGE V REFERENCE BUG

AIRSPEED/MACH No. POINTER

V REFERENCE SETTING KNOB

Bears V_{REF} orange bug symbol.

MOVING SCALE

Read against the airspeed pointer.

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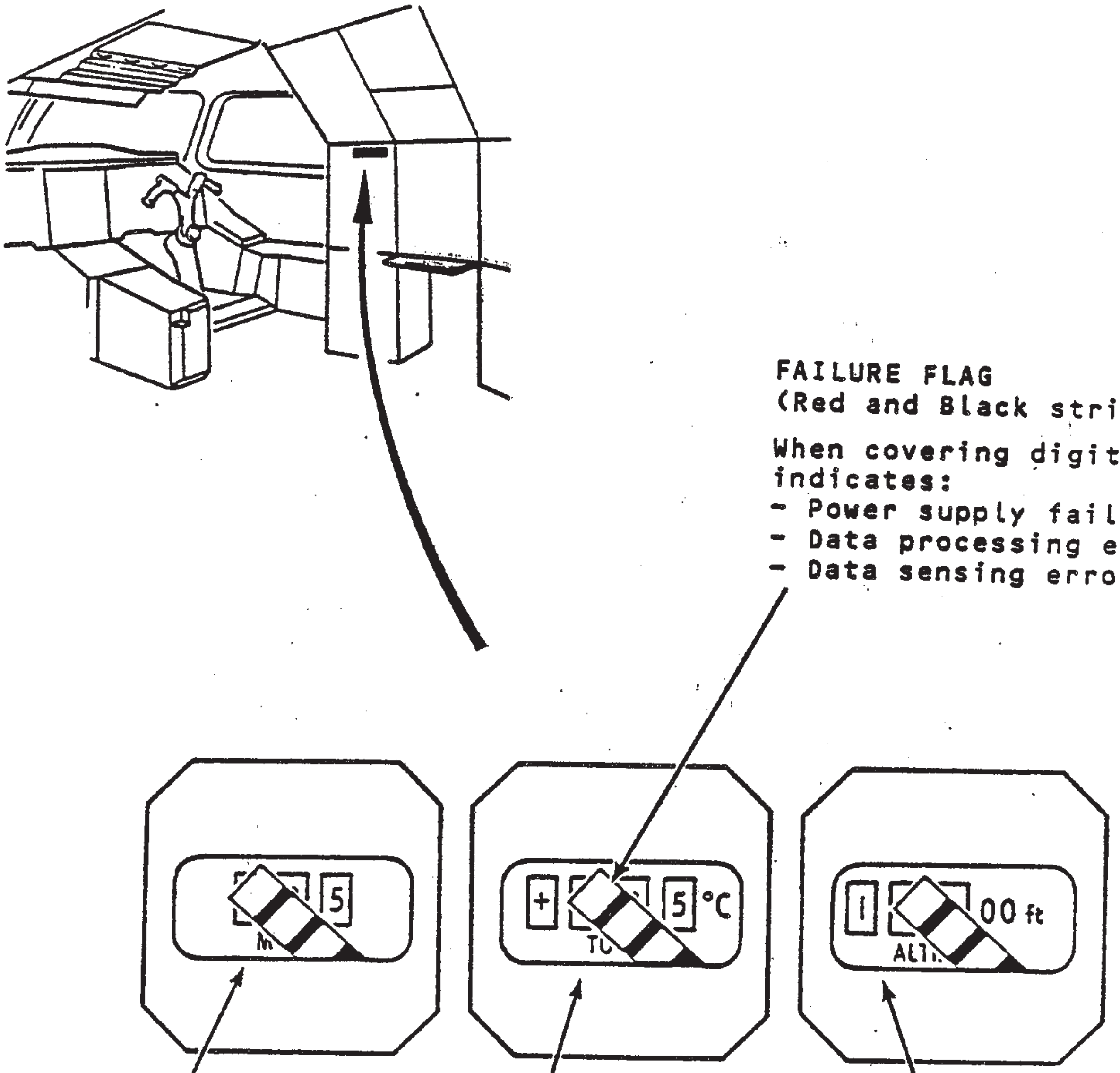
FLIGHT ENGINEERS FLIGHT INSTRUMENTS



FAILURE FLAG
(Red and Black stripes)

When covering digits indicates:
- Power supply failure.
- Data processing error.
- Data sensing error.

MACHMETER

TOTAL TEMPERATURE INDICATOR

The instrument range is:
- 50°C to + 220°C, but the left hand indicator always shows: +

ALTIMETER

When the pressure altitude reading is negative, the left hand indicator shows: −

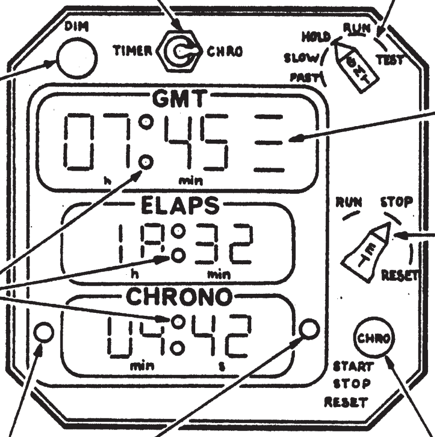
(Unchanged)

CLOCK

CAPTAIN'S CLOCK as illustrated has three displays, viz, GMT, ELAPS and CHRONO. The CHRONO display can be switched to Timer function to give a noise abatement count down facility.

CO-PILOT'S & FLIGHT ENGINEER'S CLOCKS are the same as Captain's Clock except that there is no ELAPS time facility.

NOTE: Only the Captain's Clock has the AIDS encoder.



CHRO: with switch in this position. The CHRONO indicator operates as a normal stopwatch and is controlled by three-state CHRO pushbutton.

PUSH - to start

PUSH - to stop

PUSH - to reset

TIMER: with switch in this position. The CHRONO display operates as a countdown timer.
Use GMT selector at Slow or Fast to preset the countdown value.
To start the countdown, press the CHRO button.
Stop & Reset functions are inhibited in this mode.

DIMMER CONTROL

Controls brightness of indicators and warning lights.

DIVIDER LIGHTS

Lights "ON" indicate that the particular counter is operating. Lights "OUT" - no signals to the display.

TIMER ALERT LIGHTS

In the TIMER mode only, the lights begin to flash 5 secs. before the display achieves zero. At zero secs. the lights become steady. The lights are inhibited in the CHRONO mode.

GMT SELECTOR
TEST: all display segments lit.
RUN: time of day presented on GMT display.

To achieve the following positions, the selector must first be depressed. The positions control the TIMER functions when the TIMER/CHRO switch is at TIMER and the GMT display with the TIMER/CHRO switch at CHRO.

HOLD: the selected display is frozen.
SLOW: slow slew (1 min/sec).
FAST: fast slew (100 min/sec).

NOTE

When the TIMER/CHRO switch is at TIMER, the GMT display operates as a normal clock regardless of the GMT selector position.

TENDENCY INDICATOR

0 to 14	seconds no bar lit
15 to 29	seconds bottom bar lit
30 to 44	seconds two bottom bars lit
45 to 59	seconds all three bars lit

ELAPSED TIME SELECTOR

This switch controls Elapsed Time display. It has two stable positions and one springloaded position.

"STOP" (stable) - counter stopped

"RUN" (stable) - counter operating

"RESET" (springloaded) - counter reset to zero and indicators out.

CHRO BUTTON

This pushbutton controls CHRONO display.

With TIMER/CHRO switch set to CHRO

Three-state pushbutton

PUSH - starts counter increasing

PUSH - stops counter

PUSH - resets counter to zero

With TIMER/CHRO switch set to TIMER

Single state pushbutton

PUSH - starts counter decreasing

Chapter 11

FUEL SYSTEM

FUEL SYSTEM

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FUEL SYSTEM

GENERAL

Fuel is stored in thirteen sealed tanks which are integral with the wing and fuselage structures. The tanks are arranged in three principal groups:

- Engine Feed
- Main Transfer
- Trim Transfer

This arrangement ensures that fuel is delivered to the engines at suitable flow rates, temperatures and pressures to satisfy all engine operating conditions. It provides a means of controlling and adjusting the aircraft's centre of gravity both prior to take-off and during flight to match the differing aerodynamic centre of pressure positions which occur during transonic acceleration and deceleration. The system also provides a heat sink for the dissipation of heat rejected by the air-conditioning and hydraulic systems and ensures that the temperature increase arising from kinetic heating is kept to a minimum. The use of a number of separate tanks, together with their internal bracing, reduces the amount of surging of the stored fuel. Because of the high climb rate of the aircraft, the tanks that store fuel during the climb require to be de-aerated, to ensure that air in solution in the fuel does not become a hazard.

ENGINE FEED

Each engine has its own feed system from a collector tank, however, a crossfeed system allows any engine or group of engines to be supplied from any collector tank.

An accumulator is used to provide a limited amount of fuel when a low pressure is sensed in the engine feed.

Between the LP valve and engine driven pump each feed system contains air conditioning and hydraulic heat exchangers. A fuel LP protection system, when armed, causes the fuel to the engine to bypass the air conditioning and hydraulic heat exchangers in the event of a low fuel pressure. Disarming the bypass valve circuit ensures a constant fuel flow through the heat exchanger.

MAIN TRANSFER

The collector tanks are replenished from the main transfer tanks 5, 6, 7, & 8 in a sequence that minimises the movement of the aircraft centre of gravity.

The main transfer sequence is manually initiated using the pumps in tanks 5 and 7, and is:-

Tank 5 replenishing tank 1 via the left hand pump, and tank 2 via the right hand pump.

FUEL SYSTEM

Tank 7 replenishing tank 3 via the left hand pump, and tank 4 via the right hand pump.

When tanks 5 and 7 are empty, the pumps in tanks 6 and 8 continue the transfer by:-

Tank 6 replenishing tank 1 via the left hand pump, and tank 2 via the right hand pump.

Tank 8 replenishing tank 3 via the left hand pump, and tank 4 via the right hand pump.

Transfer of fuel from the auxiliary tanks 5A and 7A is into their respective main tanks 5 and 7.

TRIM TRANSFER

The trim transfer system is used to redistribute the fuel in the trim tanks and main transfer tanks so that the aircraft centre of gravity can be moved to optimum positions for take off, subsonic and supersonic flight.

The trim transfer is normally automatically sequenced and controlled from the Flight Engineer's Panel, however there is a forward transfer override control available to the Pilots for use in abnormal circumstances requiring a rapid forward transfer of fuel.

The aft trim tank (11) has four pumps two of which PUMP GREEN and PUMP BLUE are powered by their respective hydraulic system. Thus forward transfer capability is available using electric or hydraulic power.

The trim transfer system is augmented in the aft trim condition by a reduced level operation in collector tanks 1 and 4. As tanks 1 and 4 are located well forward this moves the aircraft centre of gravity further rearward. The resultant rearward centre of gravity is the optimum for minimum trim drag in supersonic cruise.

VENTING AND PRESSURISATION

The tanks vent into a ring main gallery and thence into a scavenge tank which connects to atmosphere through vents in the rear fuselage. A scavenge pump automatically removes any fuel that has entered the scavenge tank and returns it to tank 3.

At high altitudes the fuel tanks are pressurised, thus facilitating fuel pumping and preventing fuel boiling, to a maximum of between 1.2 and 1.5 psig. This increasing differential pressure is necessary to maintain a minimum absolute tank pressure with increasing altitude.

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FUEL SYSTEM

JETTISON

The fuel jettison system utilizes part of the trim transfer system to move fuel from the trim tanks and collector tanks to a jettison outlet at the rear of the aircraft. Two engine feed pumps in each collector tank supply fuel to the jettison system.

The system ensures that sufficient fuel is retained for operation of the engines.

DE-AERATION

De-aeration is provided in tank 10 by a special pump, and in tanks 11, 6, 8, 5A and 7A by the normal pumps.

De-aeration is required in fuel tanks where the fuel remains static for relatively long periods during the climb. Under these conditions it is possible that as the fuel tank air pressure decreases, air in solution will expand causing fuel pump cavitation or transient increases in tank pressure and subsequent fuel transfer via the vent gallery.

FUEL QUANTITY INDICATION

The fuel quantity indication (FQI) system measures the fuel contents of the tanks by means of capacitance type gauging channels, and provides individual indication of each tank content at the Flight Engineers fuel management panel or alternatively, at the refuel control panel for refuelling.

The fuel gauging information is also used to provide:

(a) Total fuel indication at the centre dash panel, the fuel management panel and at the refuel control panel.

(b) Tank load limit control during trim transfer and refuelling operations.

(c) CG position indication at the pilots dash panels and the fuel management panel.

(d) CG and mach limits indication at the pilots dash panels and fuel management panel.

(e) CG and mach limit warnings at two levels within the defined flight envelope.

Load Limit Control

During the normal mode of trim transfer, fuel is pumped either from tanks 9 and 10 into tanks 11, 5 and 7 to obtain a rearward CG shift, or from tank 11 into tanks 9, 5 and 7 to obtain a forward CG shift. The trim tank contents are pre-selected on two load limit selectors, one for tanks 9 and 10 and the other for tank 11. Any fuel in excess of the trim tank requirements is transferred into tanks 5 and 7. The load limit control channels are duplicated and each one automatically continues controlling should the other channel fail.

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FUEL SYSTEM

CG Position Indication

Each CG indication is derived from any one of three channels. The Main channel is the one normally used with Standby 1 and Standby 2 channels available in the event of a main channel failure. Each channel has its own CG pack in which the CG position is computed using fuel quantity information and other fixed and manually introduced inputs.

The Main channel uses fuel quantity indication from all tanks in computing the CG.

Standby 1 channel uses fuel quantity indication from only those tanks on the left hand side of the aircraft and channel A of tanks 9, 10 and 11. For computation purposes the sum of the left hand tank moments is doubled.

Standby 2 channel computes the CG in a similar manner to Standby 1 but uses the tanks in the right hand side of the aircraft and channel B of tanks 9, 10 and 11.

CG and Mach Limits Indication

Bugs on the CG Indicators show the forward (fwd) and rear (aft) boundaries of the CG corridor relative to mach number. Bugs on the Machmeters show the maximum and minimum mach limits relative to the aircraft CG position. Both the CG and mach number band widths move relative to mach number and CG respectively.

The limits display is provided by two identical but separate channels. One is contained in the Standby 1 CG pack and serves the Captain's CG Indicator and Machmeter.

The other channel is contained in the Standby 2 CG pack and serves the First Officers Machmeter and the Flight Engineers CG Indicator.

CG and Mach Limit Warnings

CG and Mach Limit warnings are provided at two levels of CG/Mach number values. The first warning activates at a normal boundary level and the second warning activates when the normal boundary limits have been exceeded by a further margin.

The second warning level is defined as an extreme boundary. Its purpose is to indicate when corrective actions, taken at the normal boundary warning, are not producing a rapid enough correction of CG/Mach values.

The warnings are initiated through two separate channels, one in STANDBY 1 CG pack and the other in STANDBY 2 CG pack. Both channels function the master warning system, but STANDBY 1 channel activates the pilots Machmeter/CG indicator warnings and STANDBY 2 channel activates the identical warnings at the First Officer's Machmeter and the Flight Engineer's CG indicator.

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FUEL SYSTEM

The signals from the FQI of tanks 1 and 4, 2 and 3, 5 and 7, 5A and 7A, and 6 and 8 that are used in the main CG computor are sensed by a comparator. The comparator automatically disconnects a faulty gauging channel and substitutes a signal equal to the content of the remaining tank of the pair, in the event of failures.

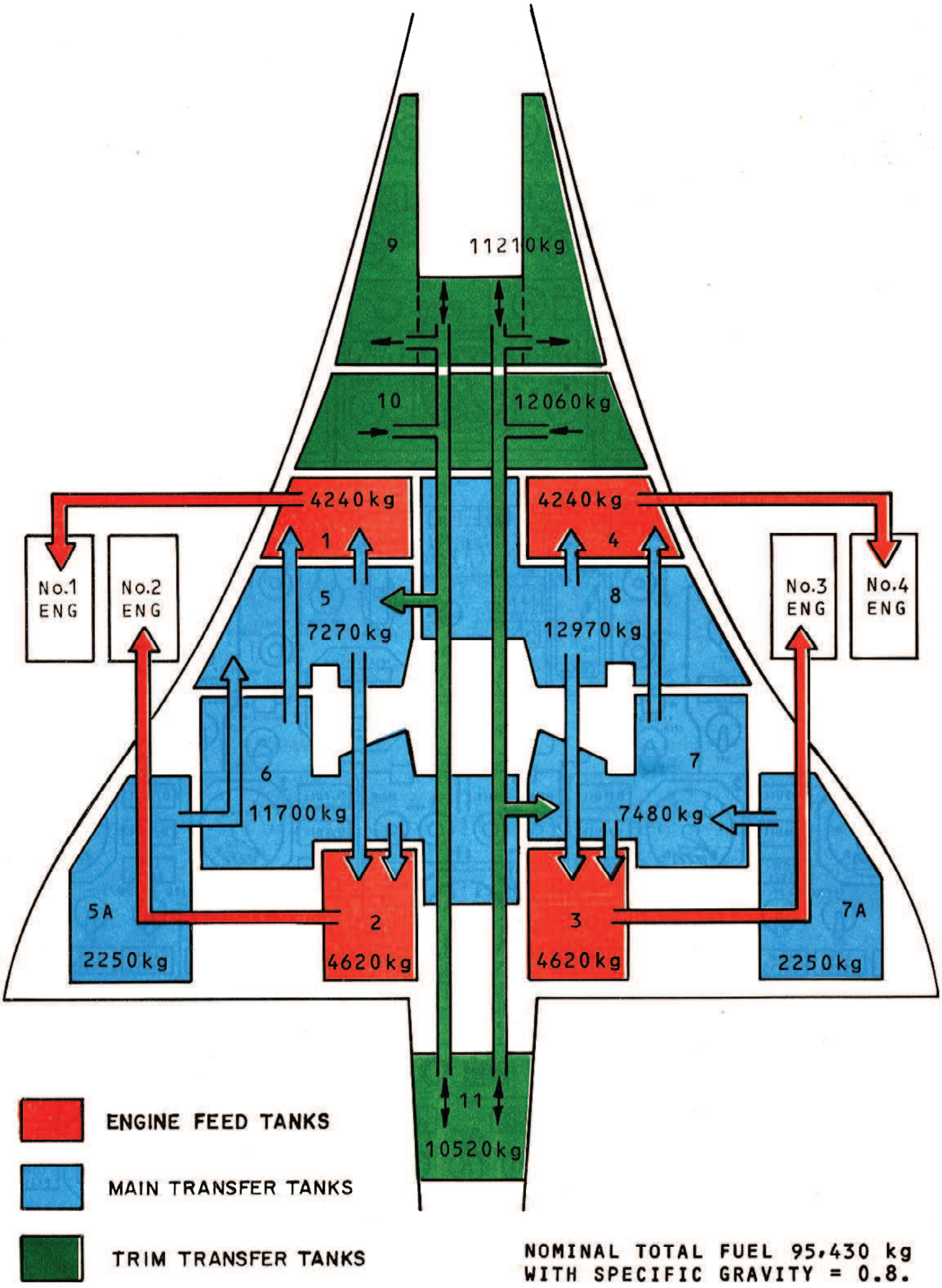
The fuel gauging of tanks 9, 10 and 11 is provided through two channels for each tank. A failure detector compares the signals from each pair of gauging channels. This detector automatically disconnects a faulty channel by removing its power supply in the event of failures.

REFUELLING

Refuelling is carried out through two refuel control units, located in the wing lower fairings forward of the main landing gear bays and connected to the trim transfer pipes. All the tanks can be refuelled simultaneously or each tank separately, for either partial or total filling, from the refuel control panel located next to the RH refuel control unit. Required quantities can be pre-selected on the refuel control panel.

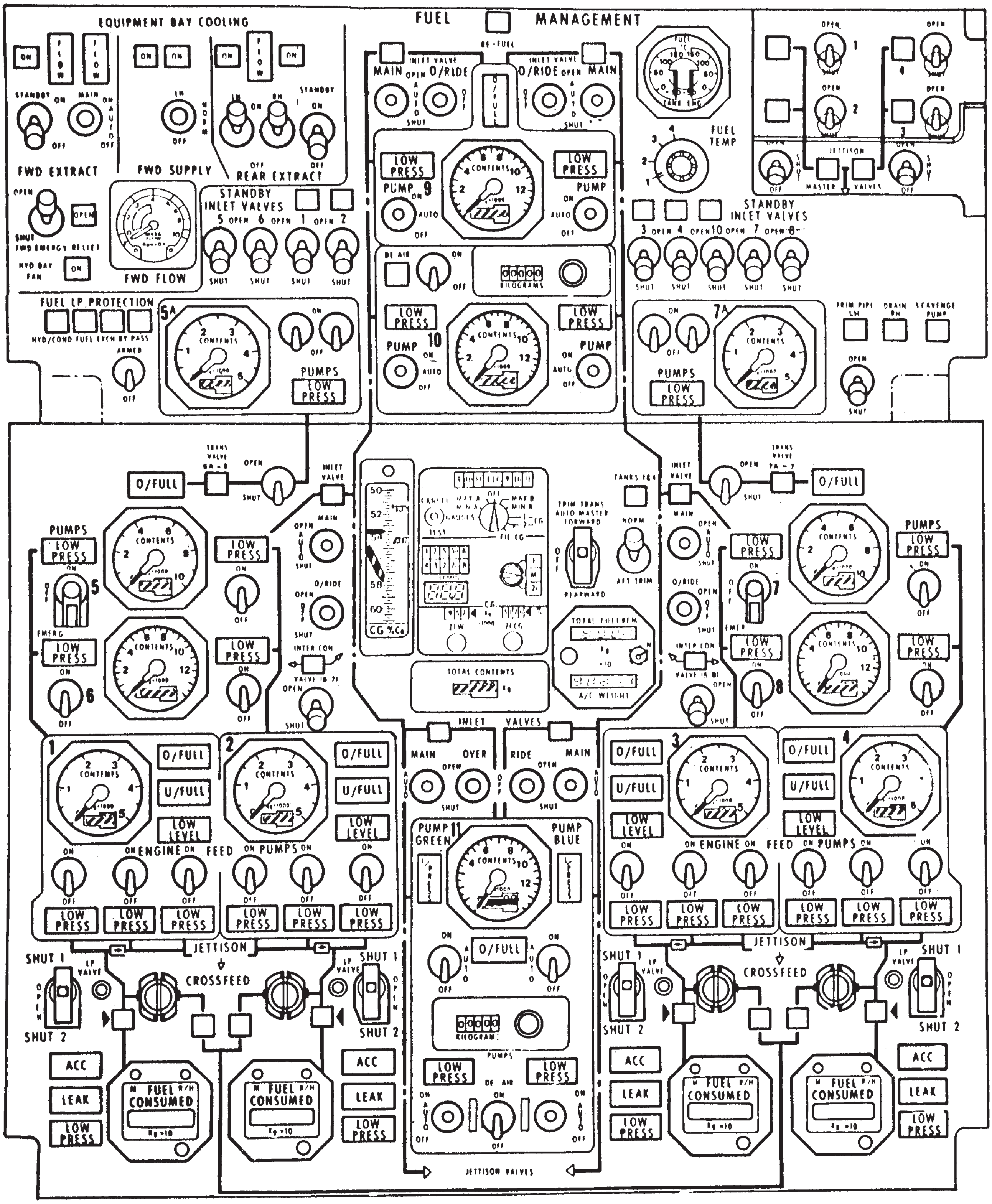
Part or all of the refuelling procedure is stopped in the event of overfilling, excess pressure, inadvertent opening of the trim valves or adverse rearward movement of the aircraft centre of gravity.

TANK LOCATION

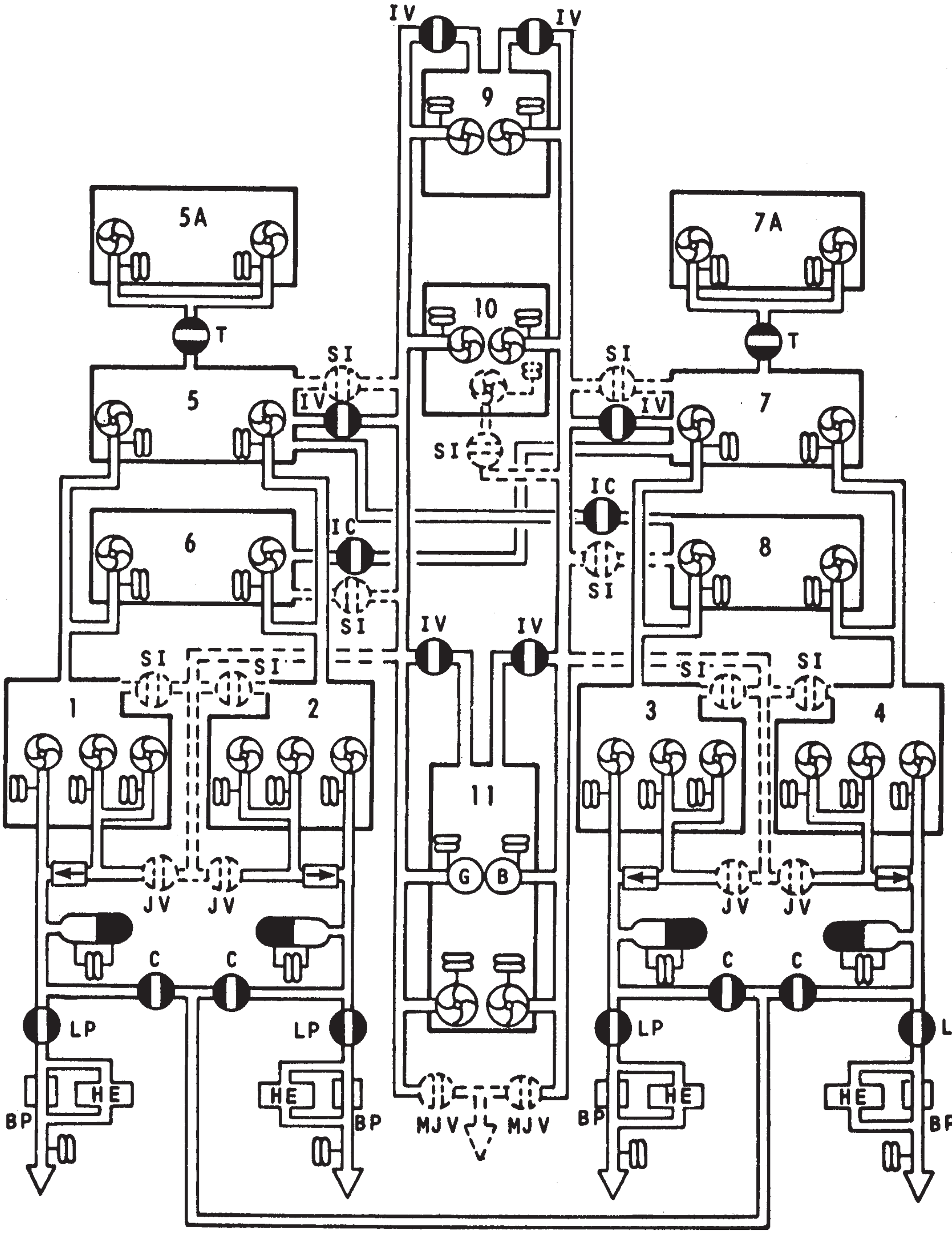


NOMINAL TOTAL FUEL 95,430 kg
WITH SPECIFIC GRAVITY = 0.8.

MANAGEMENT PANEL

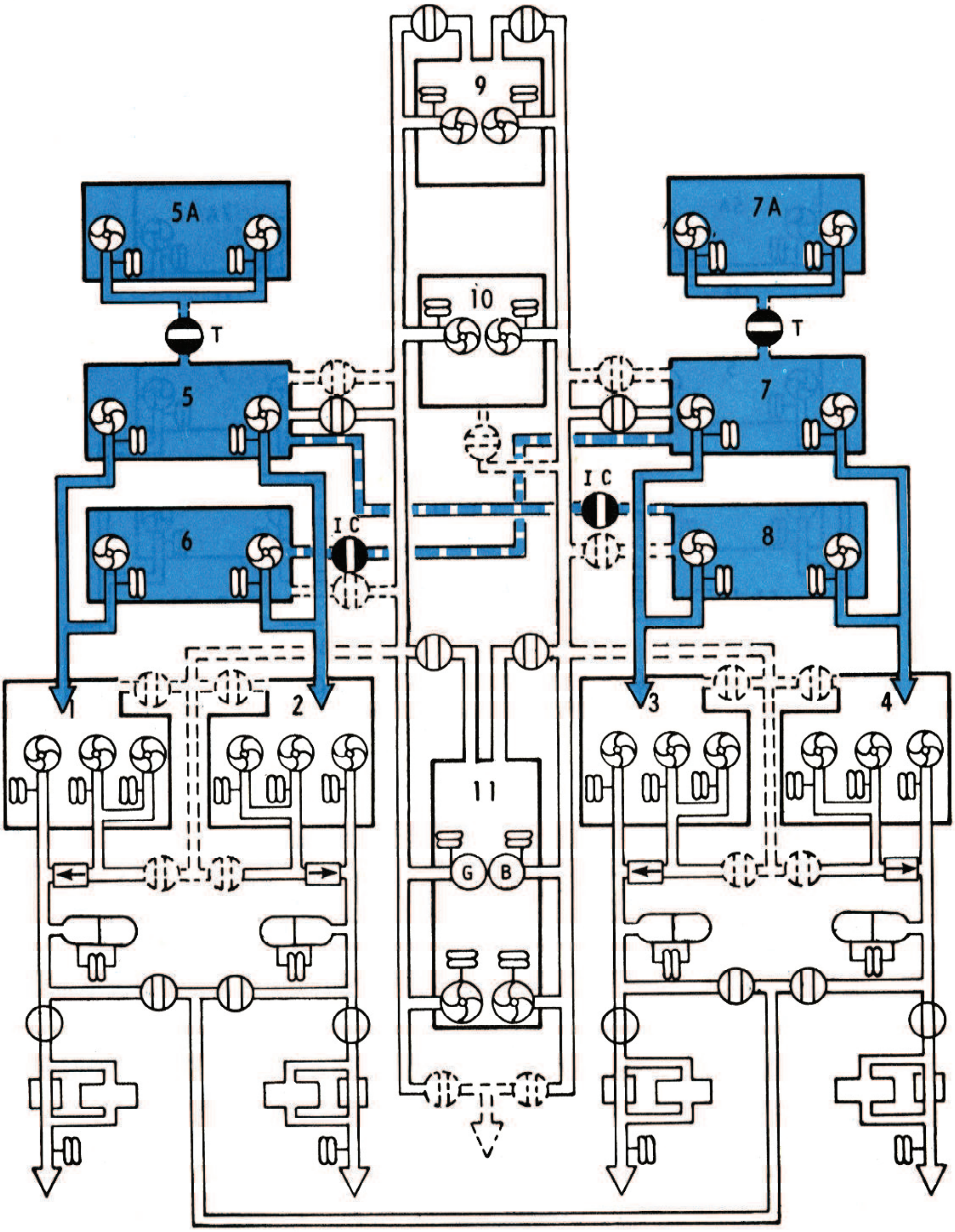


SYSTEM SCHEMATIC



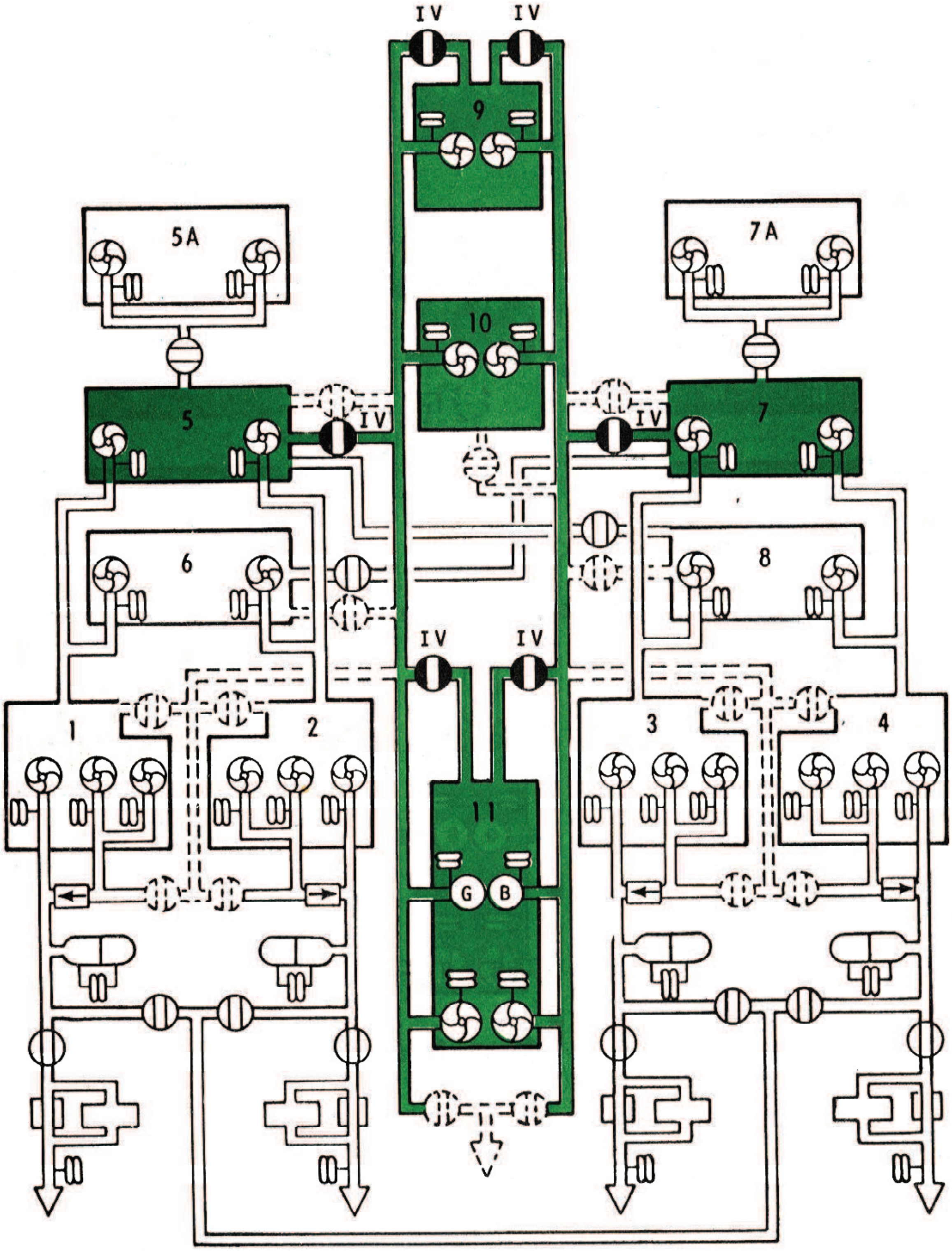
IV ◐	INLET VALVE (TRIM TRANSFER)
LP ◐	L.P. FUEL VALVE
C ◐	CROSSFEED VALVE
SI ◐	STANDBY INLET
JV ◐	TANK JETTISON VALVE
MJV ◐	MASTER JETTISON VALVE
T ⊖	TRANS VALVE
IC ◐	INTER CONNECT VALVE
	FUEL PUMP (ELECTRICAL)
(G) (B)	FUEL PUMP (HYDRAULIC)
BP	BY-PASS VALVE
HE	HEAT EXCHANGER
	FUEL ACCUMULATOR

MAIN TRANSFER



T TRANS VALVE
IC INTER CONNECT VALVE

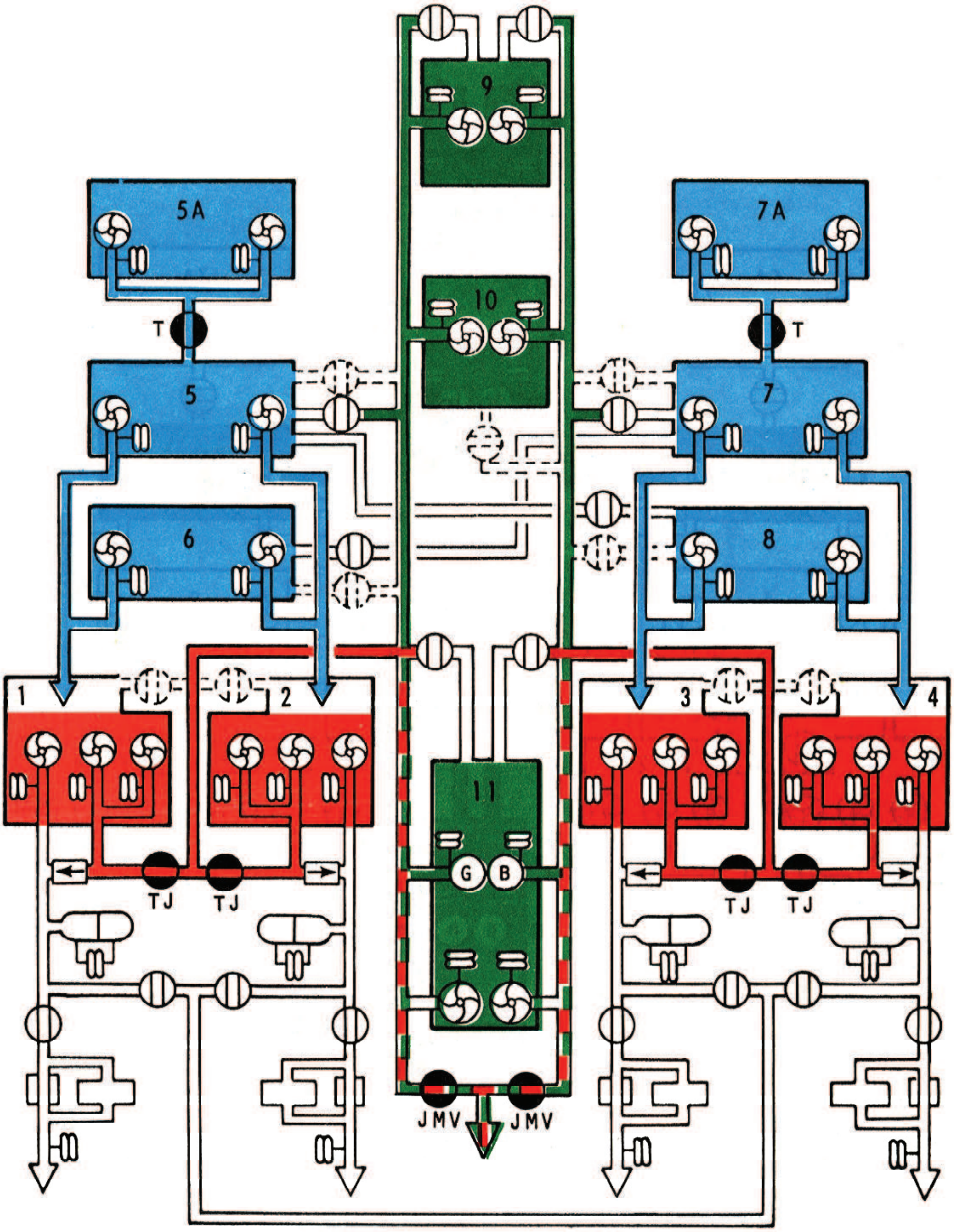
TRIM TRANSFER



IV
◐ INLET VALVE

TANKS CONCERNED DIRECTLY WITH
TRIM TRANSFER OPERATIONS

JETTISON

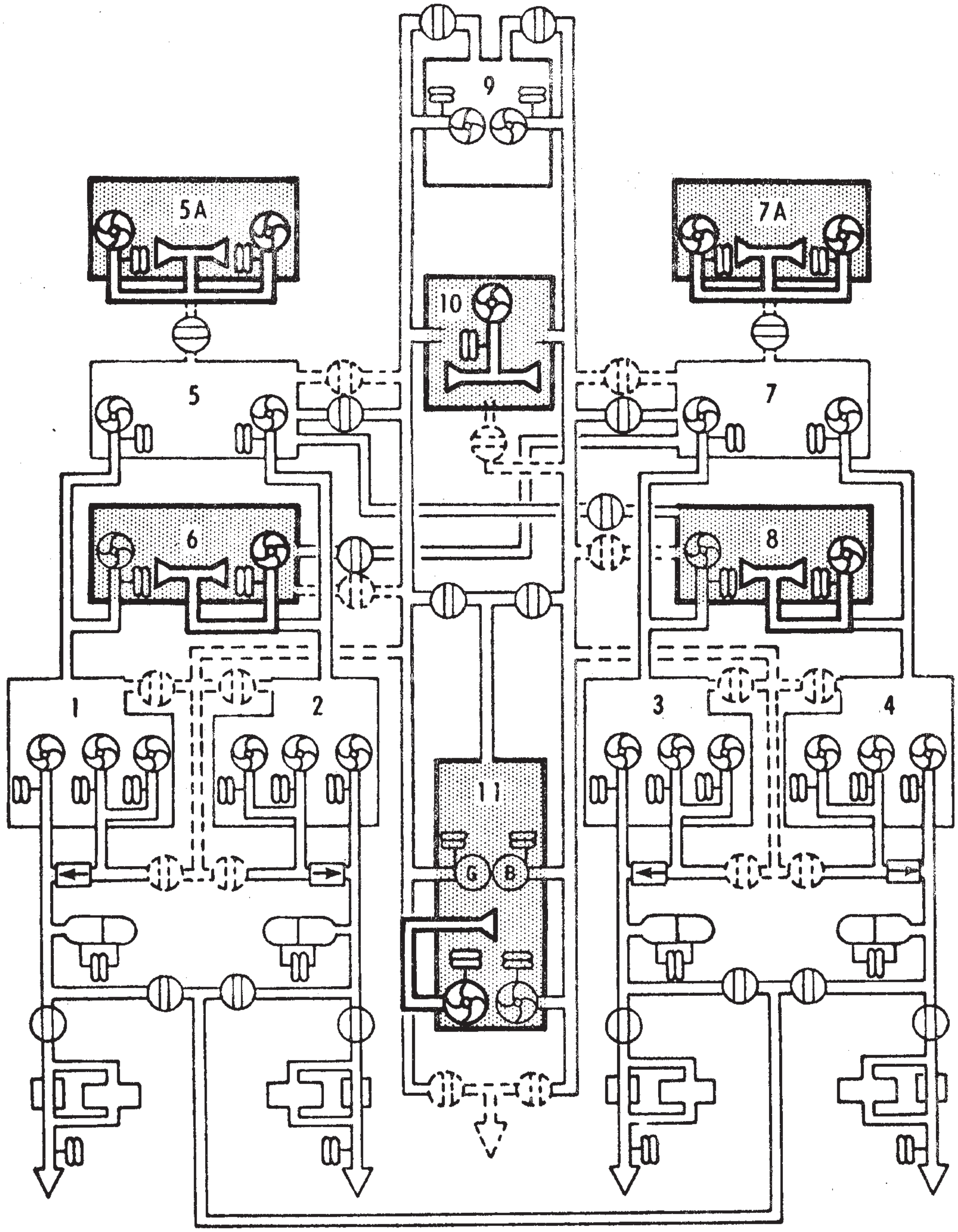


T ⊖ TRANS VALVE

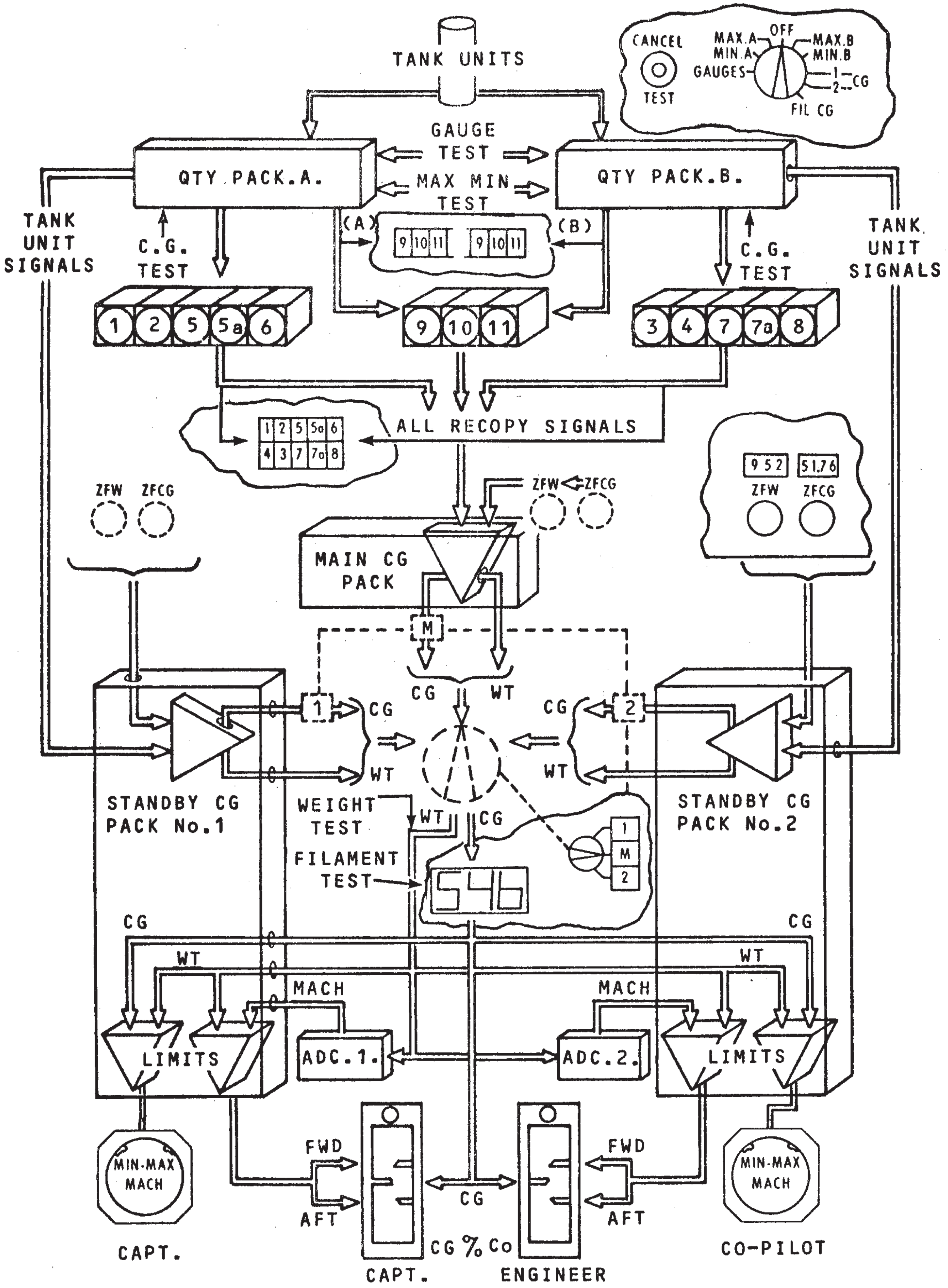
TJ ⊖ TANK JETTISON VALVE

JMV ⊖ JETTISON MASTER VALVE

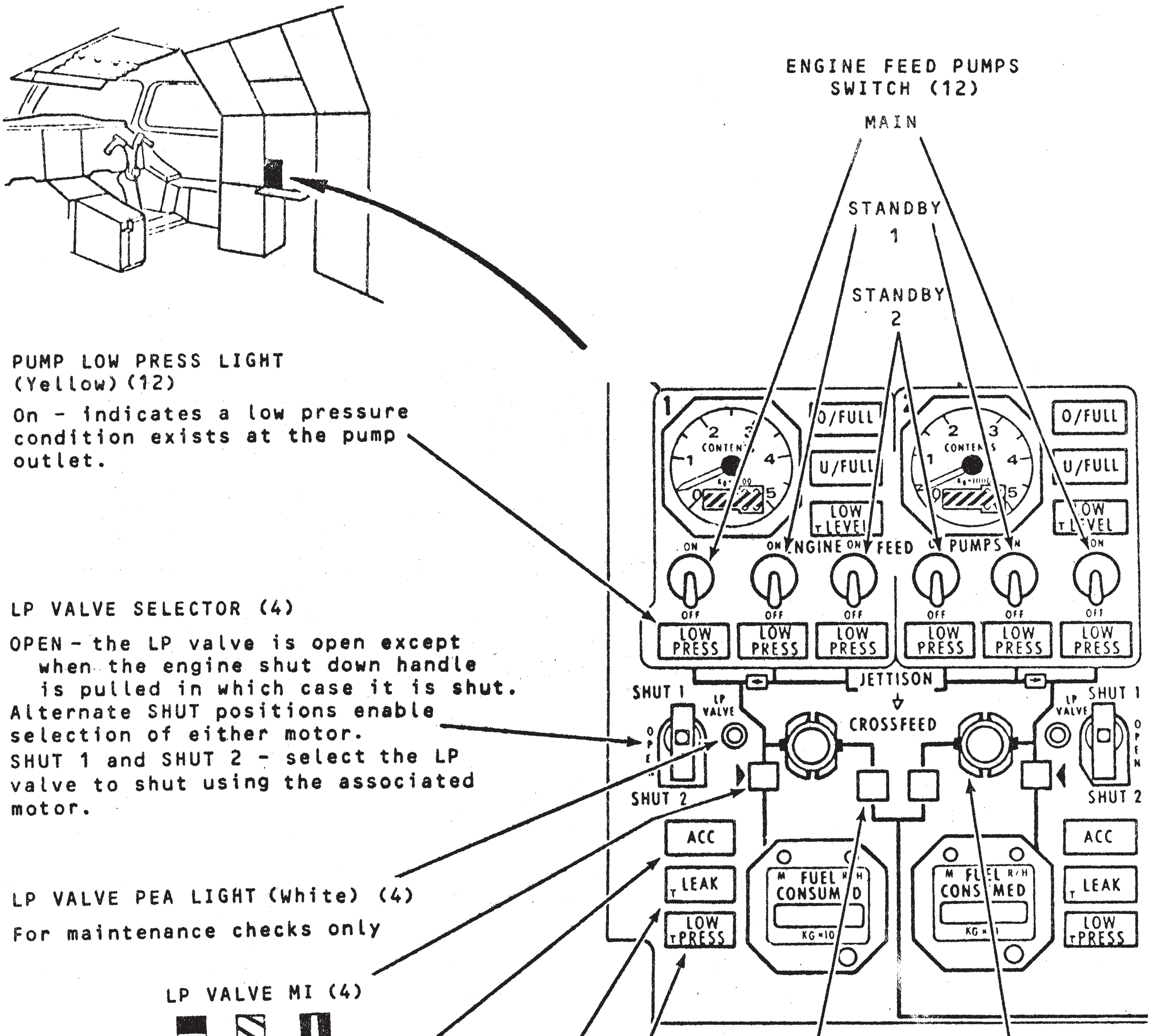
DE-AERATION



CG INDICATION AND CG/MACH LIMITS SYSTEM



ENGINE FEED



ENGINE FEED PUMPS SWITCH (12)

MAIN

STANDBY 1

STANDBY 2

PUMP LOW PRESS LIGHT (Yellow) (12)

On - indicates a low pressure condition exists at the pump outlet.

LP VALVE SELECTOR (4)

OPEN - the LP valve is open except when the engine shut down handle is pulled in which case it is shut. Alternate SHUT positions enable selection of either motor.

SHUT 1 and SHUT 2 - select the LP valve to shut using the associated motor.

LP VALVE PEA LIGHT (White) (4)

For maintenance checks only

LP VALVE MI (4)

▬ ▨ ▮

ACC LIGHT (Yellow) (4)

On - indicates either a low level fuel pressure down-stream of the collector tank pumps or a low air pressure in the accumulator.

LEAK LIGHT (Red) (4)

Refer to Power Plant Chapter.

CROSSFEED ROTARY SELECTOR (4)

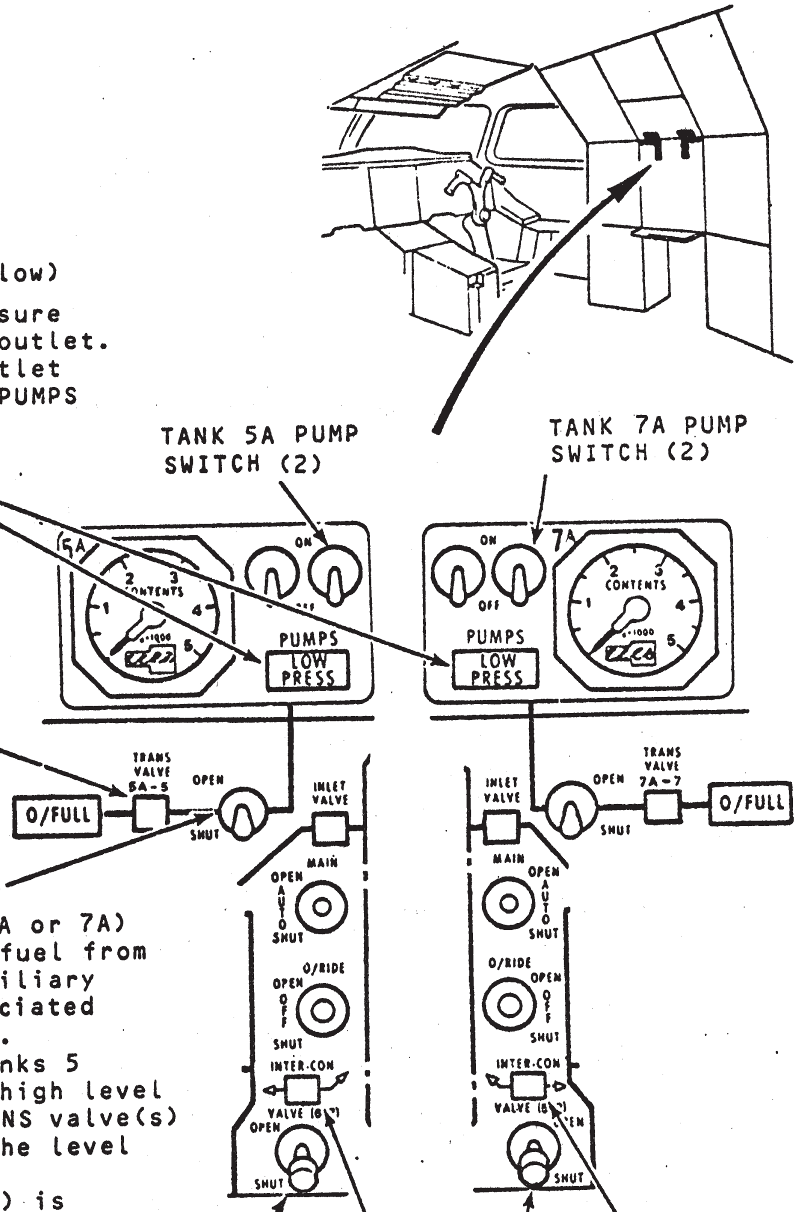
CROSSFEED MI (4)

▬ ▨ ▮

ENGINE INLET LOW PRESS LIGHT (Amber) (4)

On - indicates that a low pressure condition exists upstream of the engine pump.
Accompanied by a master warning system FUEL light (amber) and audio (gong).

MAIN TRANSFER (Sheet 1 of 2)



PUMP LOW PRESS LIGHT (Yellow)

On - indicates a low pressure condition at either pump outlet. Is armed for each pump outlet only when the associated PUMPS switch is at ON.

TANK 5A PUMP SWITCH (2)

TANK 7A PUMP SWITCH (2)

TRANS VALVE MI (2)

▬ ▨ ▮

TRANS VALVE SWITCH (2)

OPEN - allows the tank (5A or 7A) pumps to transfer fuel from the associated auxiliary tank into its associated main transfer tank.

NOTE: In the event of tanks 5 and/or 7 reaching high level the respective TRANS valve(s) will close until the level falls.

SHUT - the tank (5A or 7A) is isolated from its respective main tank thus allowing the tank (5A or 7A) pumps to de-aerate the fuel without transfer.

INTERCONNECT VALVE (6-7) MI

OPEN ▨ SHUT

INTERCONNECT VALVE (5-8) MI

OPEN ▨ SHUT

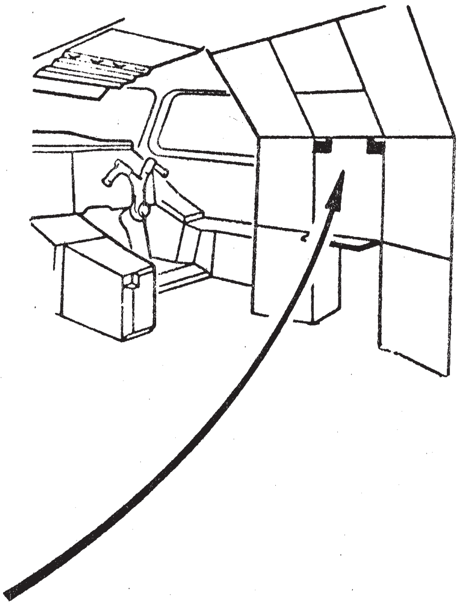
INTERCONNECT VALVE (6-7) SWITCH

OPEN - allows fuel to flow between tanks 6 and 7. The direction of flow depends only on the relative fuel levels.

INTERCONNECT VALVE (5-8) SWITCH

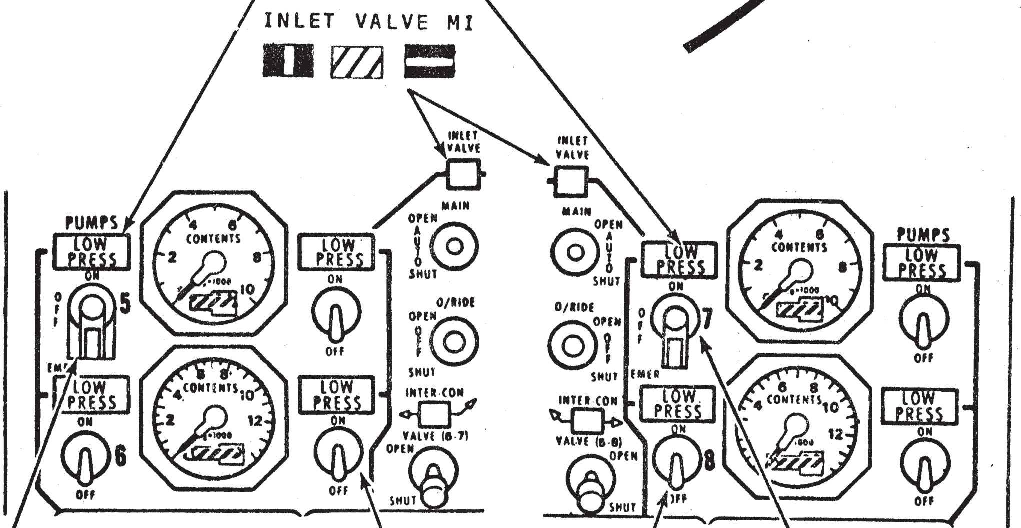
OPEN - allows fuel to flow between tanks 5 and 8. The direction of flow depends only on the relative fuel levels.

MAIN TRANSFER (Sheet 2 of 2)



MAIN TRANSFER TANK PUMP LOW PRESS LIGHT (Yellow) (8)

On - indicates a low pressure condition at the pump outlet. Is armed only when the pump switch/selector is at ON or EMER.



TANK 5 PUMP SELECTOR

Guarded to prevent inadvertent selection of EMER.

ON - transfers fuel from tank 5 to tank 1

EMER - the pump is powered from an essential busbar and the standby 1 engine feed pump of tank 2 is inhibited.

TANK 7 PUMP SELECTOR

Guarded to prevent inadvertent selection of EMER.

ON - transfers fuel from tank 7 to tank 3

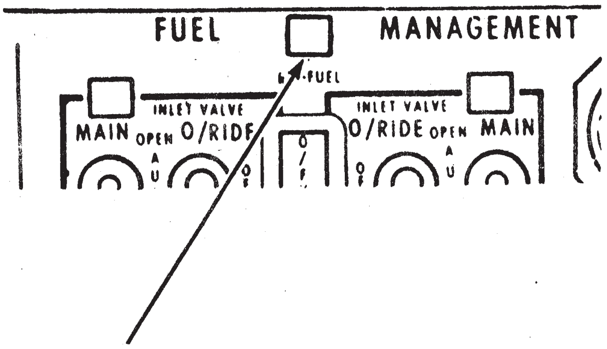
EMER - the pump is powered from an essential busbar and the standby 1 engine feed pump of tank 4 is inhibited.

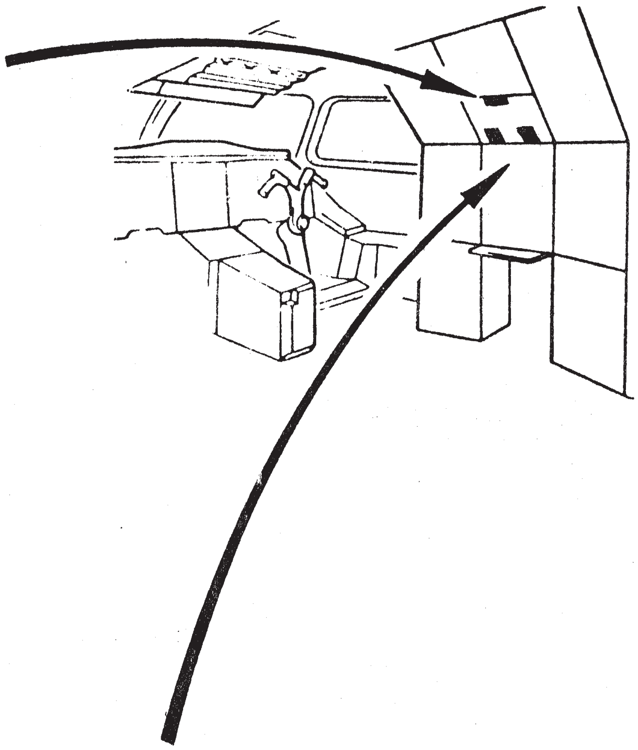
MAIN TRANSFER TANK PUMP SWITCH (6)

On - transfers fuel from tank 5 to tank 2
" " " " 7 " " 4
" " " " 6 " " 1 via the LH pump
" " " " 6 " " 2 " " RH "
" " " " 8 " " 3 " " LH "
" " " " 8 " " 4 " " RH "

NOTE: When tank 6 and tank 8 right hand pumps are used for de-aeration no transfer occurs as tank 5 and tank 7 fuel is transferred preferentially.

TRIM TRANSFER/REFUEL

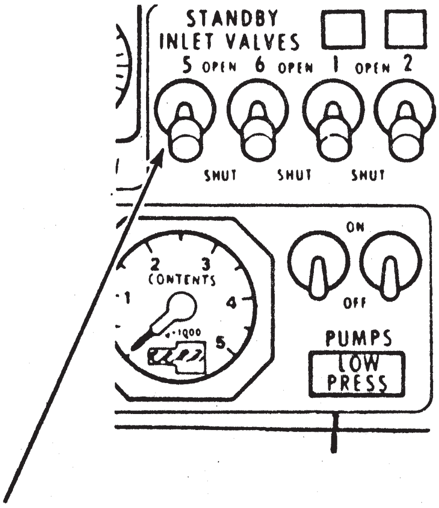


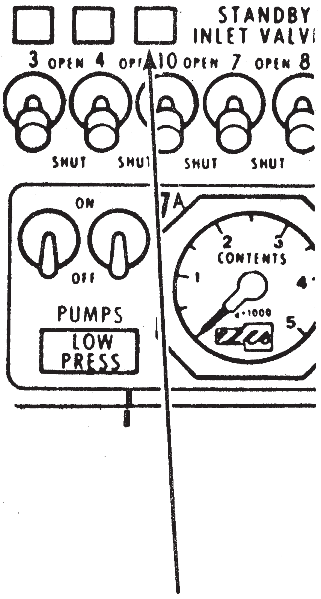


REFUEL MI

GRD - indicates that the refuelling access panel is open and/or the REFUEL MASTER selector is not at OFF/DEFUEL

FLT - indicates that the REFUEL MASTER selector is set to OFF/DEFUEL and the refuelling access panel is closed thus isolating the refuel panel from the normal aircraft fuel system.





STANDBY INLET VALVES SWITCH (9)

OPEN - allows fuel from the main trim transfer pipe to enter directly into the appropriate tank.

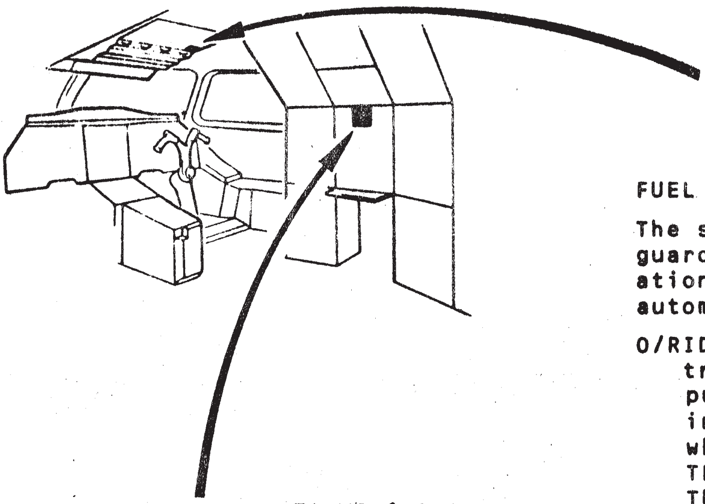
NOTE: During refuelling the standby inlet valves are used as refuelling valves and controlled by switches on the refuel panel.

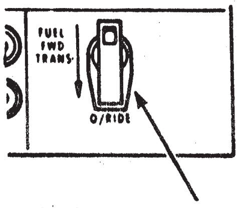
STANDBY INLET VALVE MIs (TANKS 1, 2, 3, 4 and 10)

OPEN ▨ SHUT

These MIs are provided only for those STANDBY INLET VALVES 1,2,3,4 and 10, that may be used in procedures that require monitoring of the valves.

TRIM TRANSFER (Sheet 1 of 3)

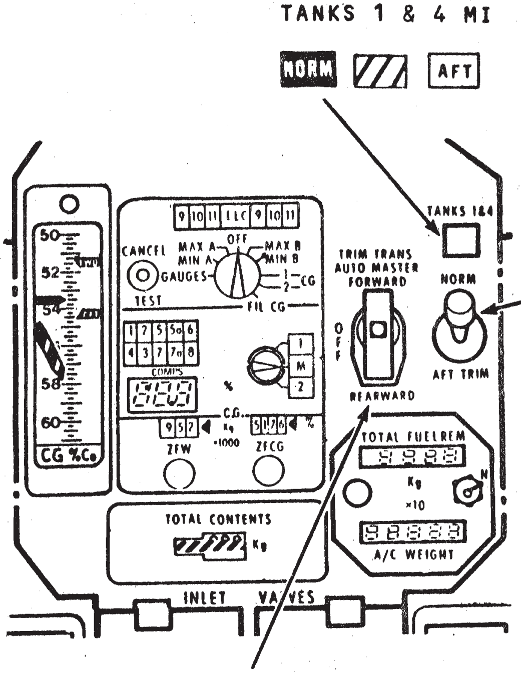




FUEL FORWARD TRANSFER SWITCH

The switch is only removed from its guarded position in an abnormal situation requiring an override of the automatic trim transfer system.

O/RIDE - initiates an automatic forward transfer sequence provided tank 11 pump selectors and tank 9, 5 and 7 inlet valve selectors are at AUTO, whatever the position of the TRIM TRANS AUTO MASTER selector.
The sequence is:-
Tank 11 pumps on.
Tank 9 inlet valves open.
Then when tank 9 reaches high level.
Tank 9 inlet valves close and tanks 5 and 7 inlet valves open.



TANKS 1 AND 4 SWITCH

NORM - allows the main transfer control valves to maintain tanks 1 and 4 at nearly full level.

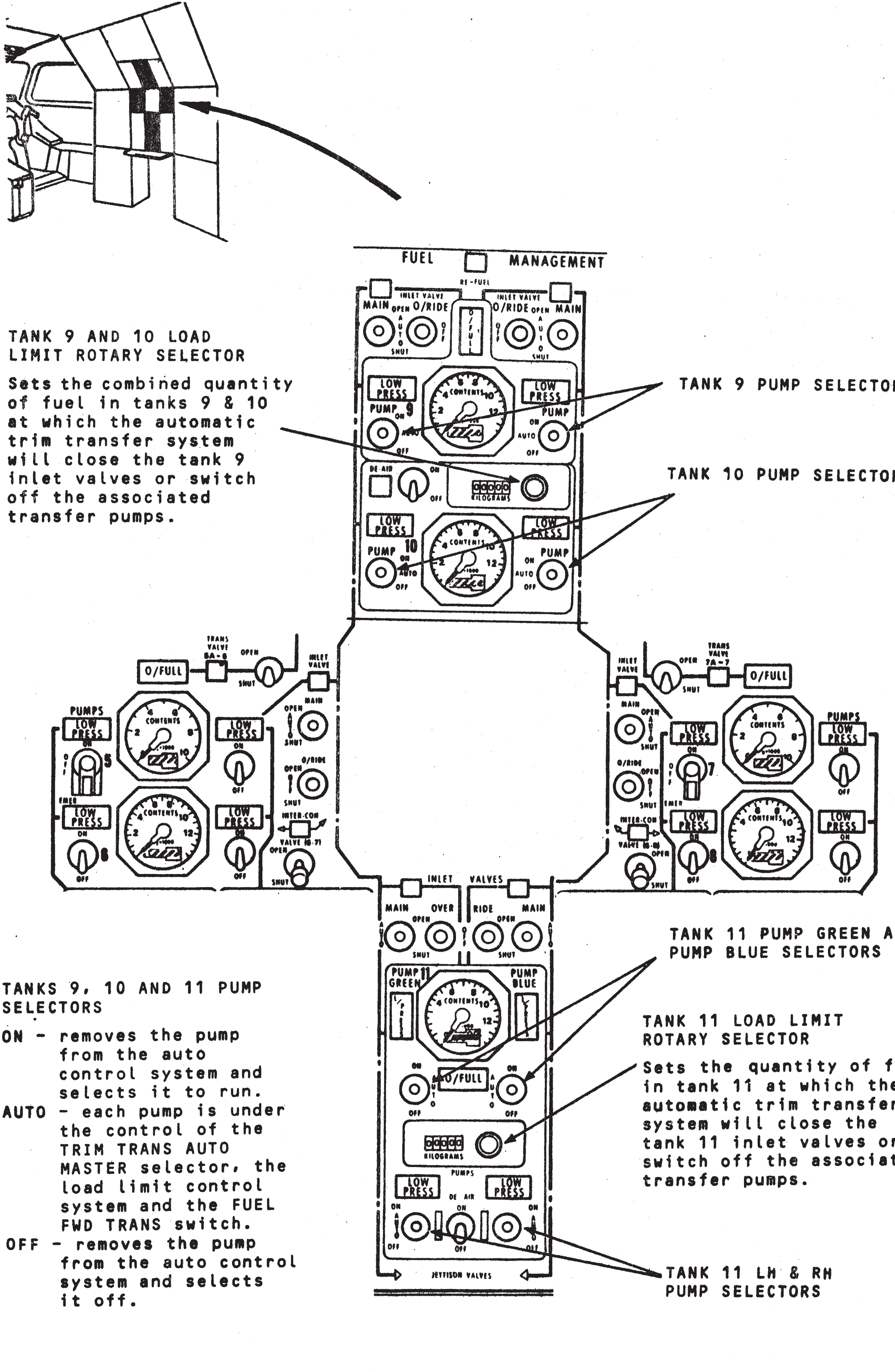
AFT TRIM - selects a reduced fuel level operation in tanks 1 and 4 and inhibits the underfull warning. The reduced operating level is 40% of the nominal volume.

TRIM TRANSFER AUTO MASTER SELECTOR

FORWARD - provided the associated inlet valve and pump selector are at AUTO, initiates an automatic forward transfer sequence.
The sequence is:-
Tank 11 pumps on and tank 9 inlet valves open then when tank 9 reaches the preset load limit or high level, tank 9 inlet valves close and tanks 5 and 7 inlet valves open.
Then when tank 11 preset load limit is reached, tank 11 pumps off and tanks 5 and 7 inlet valves close.

REARWARD - switches and latches off the de-aeration mode of tank 11 left-hand pump and provided the associated inlet valve and pump selector are at AUTO, initiates the automatic rearward transfer of fuel.
The sequence is:-
Tank 9 pumps on to pump fuel into the trim transfer pipes and tank 11 inlet valves open to allow the fuel into tank 11.
Then when tank 11 reaches the preset load limit or high level, tank 11 inlet valves close and tank 5 and 7 inlet valves open to allow fuel into tanks 5 and 7 provided their contents are below high level.
Then when tank 9 is empty and its LOW PRESS lights (yellow) come on.
Tank 10 pumps on.
Then when tanks 9 and 10 preset load limit is reached tanks 9 and 10 pumps off and tanks 5 and 7 inlet valves close.

TRIM TRANSFER (Sheet 2 of 3)



TANK 9 AND 10 LOAD LIMIT ROTARY SELECTOR

Sets the combined quantity of fuel in tanks 9 & 10 at which the automatic trim transfer system will close the tank 9 inlet valves or switch off the associated transfer pumps.

TANK 9 PUMP SELECTORS

TANK 10 PUMP SELECTORS

TANKS 9, 10 AND 11 PUMP SELECTORS

- ON - removes the pump from the auto control system and selects it to run.
- AUTO - each pump is under the control of the TRIM TRANS AUTO MASTER selector, the load limit control system and the FUEL FWD TRANS switch.
- OFF - removes the pump from the auto control system and selects it off.

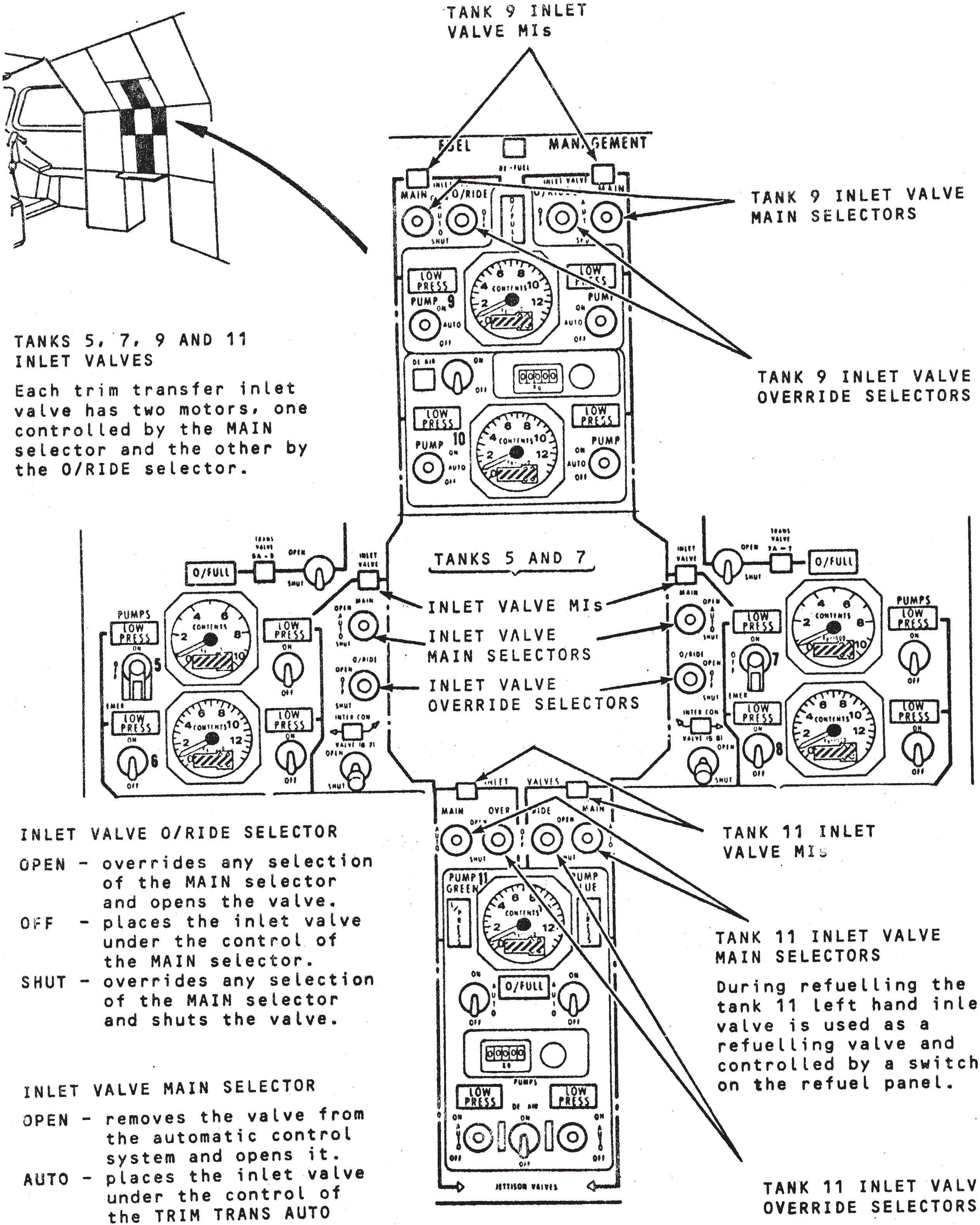
TANK 11 PUMP GREEN AND PUMP BLUE SELECTORS

TANK 11 LOAD LIMIT ROTARY SELECTOR

Sets the quantity of fuel in tank 11 at which the automatic trim transfer system will close the tank 11 inlet valves or switch off the associated transfer pumps.

TANK 11 LH & RH PUMP SELECTORS

TRIM TRANSFER (Sheet 3 of 3)



TANKS 5, 7, 9 AND 11 INLET VALVES

Each trim transfer inlet valve has two motors, one controlled by the MAIN selector and the other by the O/RIDE selector.

During refuelling the tank 11 left hand inlet valve is used as a refuelling valve and controlled by a switch on the refuel panel.

INLET VALVE O/RIDE SELECTOR

OPEN - overrides any selection of the MAIN selector and opens the valve.
OFF - places the inlet valve under the control of the MAIN selector.
SHUT - overrides any selection of the MAIN selector and shuts the valve.

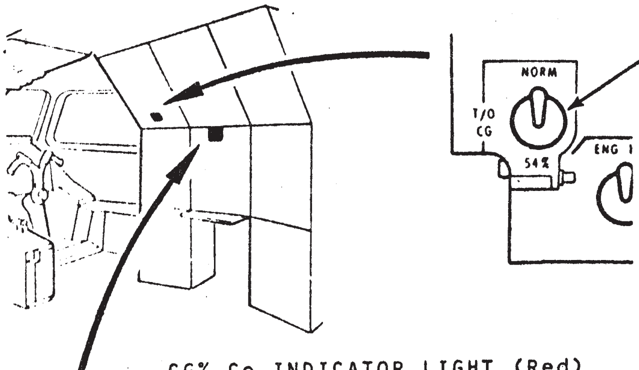
INLET VALVE MAIN SELECTOR

OPEN - removes the valve from the automatic control system and opens it.
AUTO - places the inlet valve under the control of the TRIM TRANS AUTO MASTER selector, the load limit control system and the FUEL FWD TRANS switch.
SHUT - removes the valve from the automatic control system and shuts it.

INLET VALVE MIs

▬ ▨ ▮

QUANTITY AND LEVEL (Sheet 1 of 4)



T/O CG SWITCH

NORM - the take-off aft CG boundary used by the M/CG warnings is 53.5%

54% - the take-off aft CG boundary used by the M/CG warnings is 54.0%

NOTE

The switch is latched at 54% but will automatically unlatch and return to NORM when the tank 9 or 10 pumps come on for rearward fuel transfer.

CG% Co INDICATOR LIGHT (Red)

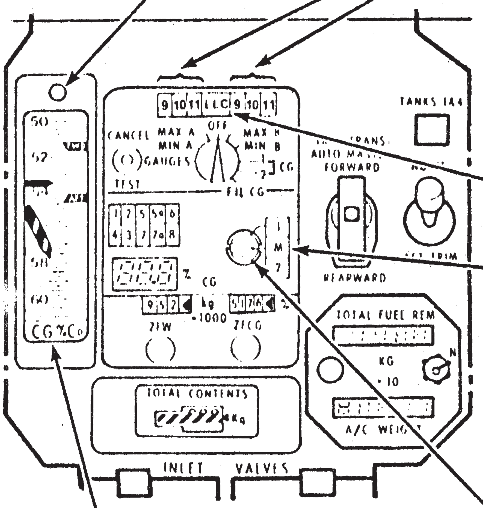
On - steady, indicates infringement of either the forward or aft boundary of the defined flight envelope.

On - flashing, indicates infringement of the forward or aft extreme boundary of the defined flight envelope.

Accompanied by MWS M/CG light (red), pilot's M/CG lights (red) and audio (gong).

9, 10, 11 LIGHTS (Yellow)

On - indicates that the failure detector has detected a failure in one of the tanks pair of gauging channels and has disconnected it from the FQI drive.



LLC LIGHT (Yellow)

On - indicates a disparity between the signal from two load limit control channels.

CG CHANNEL LIGHT (Amber) (3)

On indicates a failure of the channel. If the selected channel fails the light is accompanied by a c.g. flag on the machmeters, a failure flag on the c.g. indicators, the MWS CG light (amber) and audio (gong).

CG% Co INDICATOR
(Repeated on Captain's instrument panel).

The CG limit bugs are orange pointers labelled FWD and AFT on the right-hand side of the instrument.
The red and black diagonal striped flag appears across the middle of the scale to indicate a servo imbalance, bugs jammed, loss of power supply and loss of validity signal to the CG pointer.

CG CHANNEL ROTARY SELECTOR

M - selects the main computer for CG system. The main channel uses inputs of ZFW, ZFCG and all (13) FQIs.

1 - selects standby computer 1 for the CG system.
The standby 1 channel uses inputs of ZFW, ZFCG and FQIs for tanks 1, 2, 5, 5A and 6 plus A channel in tanks 9, 10 and 11.

2 - selects standby computer 2 for the CG system.
The standby 2 channel uses inputs of ZFW, ZFCG and FQIs for tanks 3, 4, 7, 7A and 8 plus B channel in tanks 9, 10 and 11.

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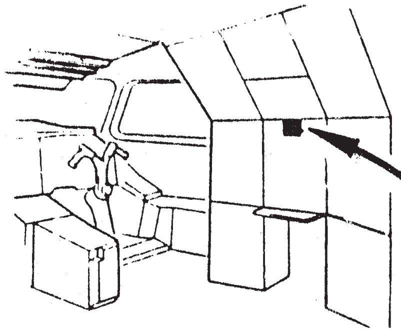
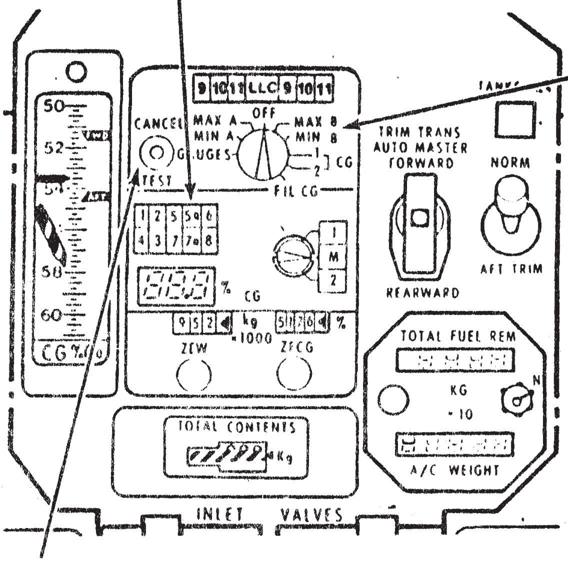
ENGLAND

QUANTITY AND LEVEL (Sheet 2 of 4)



COMPARATOR LIGHT (Yellow) (10)

On - indicates that one channel of the pair has been disconnected by the comparator because of a gauging channel failure and that the signal from the remaining tank of the pair is being used for CG computation.



FQI TEST SWITCH

CANCEL - cancels the test and resets the comparator; also resets the comparator and cancels the comparator warning provided that the difference in the two tanks contents is within the dead band i.e.

Tanks 5A/7A = 375 Kg
Tanks 5/7 = 2000 Kg
Tanks 6/8 = 2700 Kg
Tanks 1,2,3,4 = 750 Kg

TEST - Refer to FQI TEST ROTARY SELECTOR.

The selector is spring returned to the mid position.

FQI TEST ROTARY SELECTOR

GAUGES - with TEST selected, signals preset quantity increases to all FQIs. The result of this apparent weight increase and 1% aft CG shift are indicated on, and test all aircraft fuel quantity and CG indications. At the same time the resultant incompatibility between CG and Mach number, tests the MACH/CG warnings, the CG% Co warnings and their connection to the MWS.

MIN A - with TEST selected, simulates a fault in the tanks 9, 10, 11 FQI pointer drive thus testing the fault detection. The test is latched until CANCEL is selected.

MAX A
MAX B
MIN B } - MIN and MAX refer to the two independent comparator circuits that sense FQI failures downwards and upwards from the correct reading. A and B refer to the duplicated FQI channels of tanks 9, 10, and 11 provided to give adequate reliability to the automatic transfer system.

1 CG - with TEST selected, tests the CG computor by causing the 1 CG to go in excess of 1% rearward thereby testing the 1-M-2 comparator.

2 CG - with TEST selected, tests the CG computor by causing the 2 CG to go in excess of 1% rearward, thereby testing the 1-M-2 comparator

FIL - with TEST selected, tests the filaments of the CG digital display.

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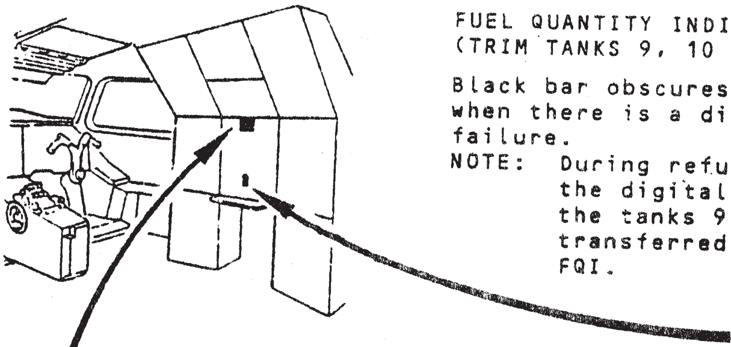
(Unchanged)

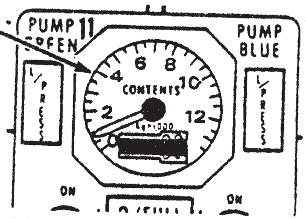
QUANTITY AND LEVEL (Sheet 3 of 4)



FUEL QUANTITY INDICATOR
(TRIM TANKS 9, 10 and 11)

Black bar obscures the digital counter when there is a digital indication failure.

NOTE: During refuelling the supply to the digital indicator motors of the tanks 9, 10 and 11 FQI is transferred to the refuel panel FQI.



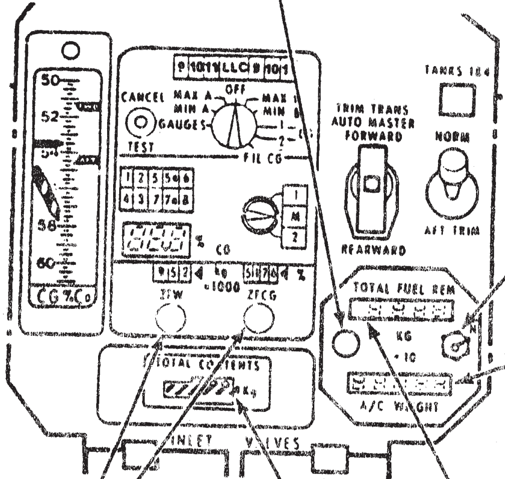
LH KNOB

Pulling and releasing with RH rotary selector at any position other than "N" zeroes the TOTAL FUEL REM indicator. Pressing and holding - with the RH rotary selector at "N" tests the digital indicators which will all read 8's.

TOTAL FUEL REM AND A/C WEIGHT ROTARY SELECTOR

N - normal position, this rotary selector must be set to "N" in normal use; ie, after insertion of new values, otherwise the A/C WEIGHT and TOTAL FUEL REM will not operate

OTHER POSITIONS - the A/C WEIGHT indicator displays five digits, one digit at a time starting with the least significant figure. One digit at a time is selected by rotating the rotary selector counter-clockwise from "N" to the first dot and so on to the fifth dot. At each position the digit number is changed by pressing the left hand knob. Each press increases the digit value by one. The setting procedure for the TOTAL FUEL REM indicator is the same as that for A/C WEIGHT, and as the numbers are set in the TOTAL FUEL REM indicator, they will be added to the A/C WEIGHT indication.



RH ROTARY SELECTOR

A/C WEIGHT DIGITAL INDICATOR

TOTAL FUEL REM DIGITAL INDICATOR

Shows the total fuel by subtracting the fuel consumed readings from the datum settings

ZFW and ZFCG SETTING KNOBS

Pull to operate.
Turn clockwise to increase digital readings.
Turn counter-clockwise to decrease digital readings.

TOTAL CONTENTS INDICATOR

(Repeated on Pilot's centre instrument panel).
Shows the total fuel on board by summing the individual FQI readings.
A flag across the digital readout indicates either:
A loss of electrical power to instrument,
A jamming of the counters,
or that the contents of two collector tanks indicate less than 1000 kg. each.

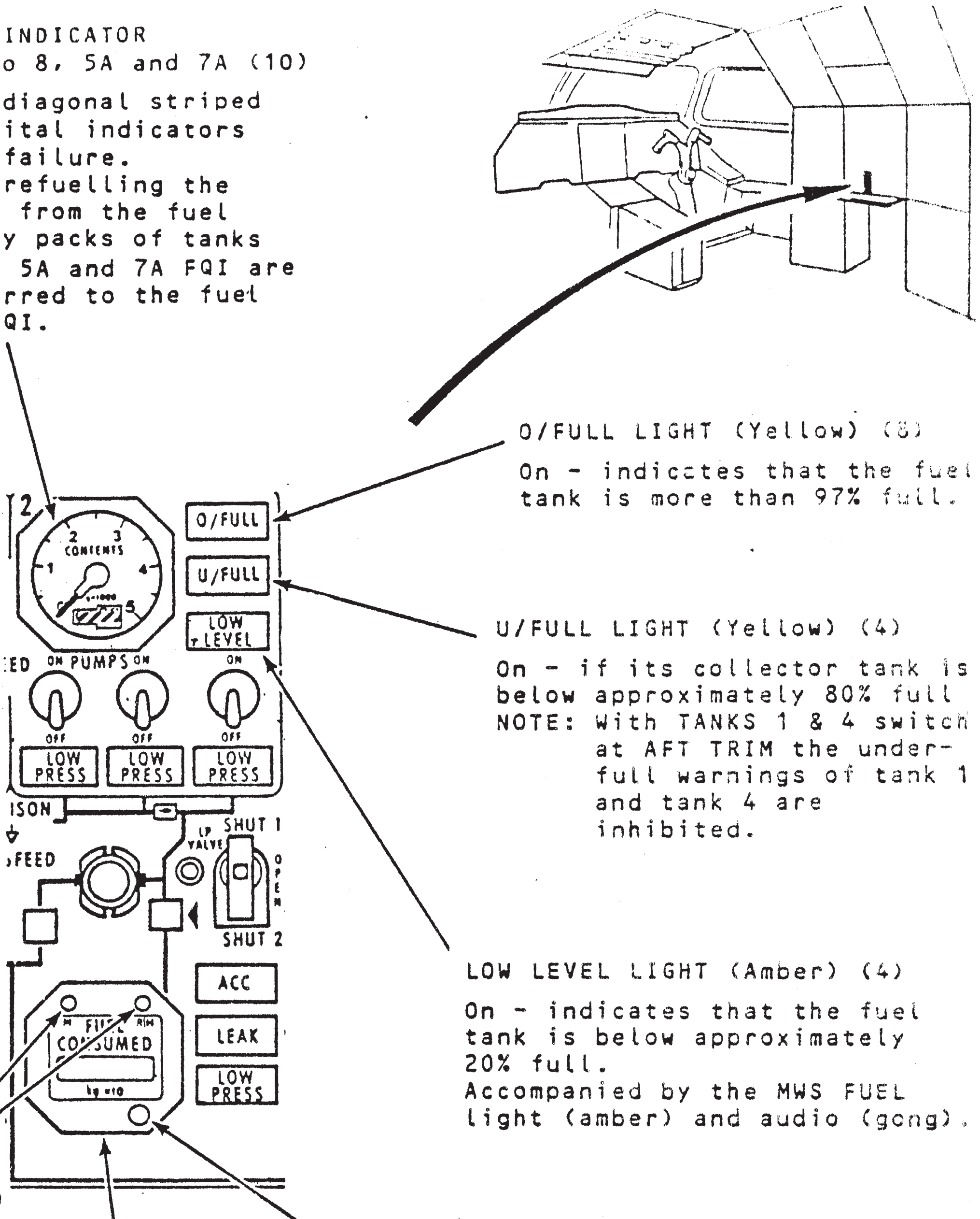
NOTE: THE TOTAL CONTENTS indicator should not normally be used as a primary source of information, except as required by the FUEL JETTISON procedure, or in the case of flowmeter failure.

QUANTITY AND LEVEL (Sheet 4 of 4)

FUEL QUANTITY INDICATOR
(FOR TANKS 1 to 8, 5A and 7A (10)

Red and black diagonal striped bar across digital indicators indicates FQI failure.

NOTE : During refuelling the signals from the fuel quantity packs of tanks 1 to 8, 5A and 7A FQI are transferred to the fuel panel FQI.



O/FULL LIGHT (Yellow) (8)

On - indicates that the fuel tank is more than 97% full.

U/FULL LIGHT (Yellow) (4)

On - if its collector tank is below approximately 80% full

NOTE: With TANKS 1 & 4 switch at AFT TRIM the under-full warnings of tank 1 and tank 4 are inhibited.

LOW LEVEL LIGHT (Amber) (4)

On - indicates that the fuel tank is below approximately 20% full.
Accompanied by the MWS FUEL light (amber) and audio (gong).

M (MAIN AND R/H (REHEAT) LIGHT (yellow)

On - indicates a fault in the density compensation system.

RESET/TEST KNOB

When pulled and turned counter-clockwise resets the indicator to zero.
When turned clockwise and held for 3 seconds tests the filaments of the display.
Then providing the associated engine is running, when the knob is released the M light (yellow) and R/H light (yellow) illuminate for 3 seconds, to indicate that the density compensation system of the associated fuel flow transmitter is operative. This confirms the integrity of the density compensation and hence the accuracy of the fuel flow signals to the power management lights and reheat control systems.

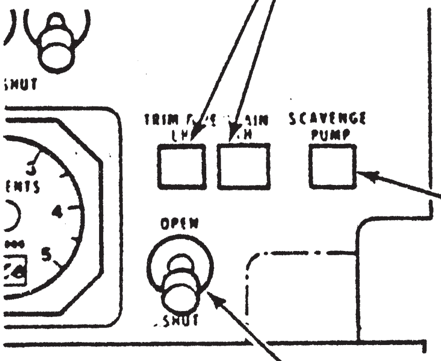
FUEL CONSUMED INDICATOR (4)

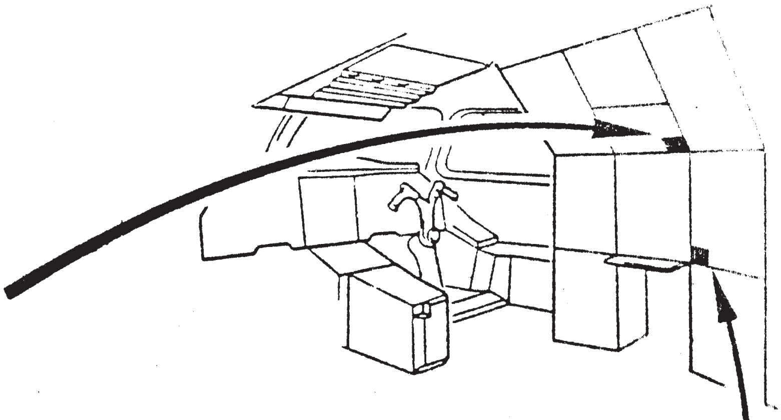
Shows the fuel consumed by the engine integrated from its flow meter.

SCAVENGE AND TANK PRESSURE

TRIM PIPE DRAIN VALVE MIs

OPEN ▨ **SHUT**





TRIM PIPE DRAIN SWITCH

OPEN - both trim pipe drain valves connect the main trim transfer pipes to the vent scavenge tank.

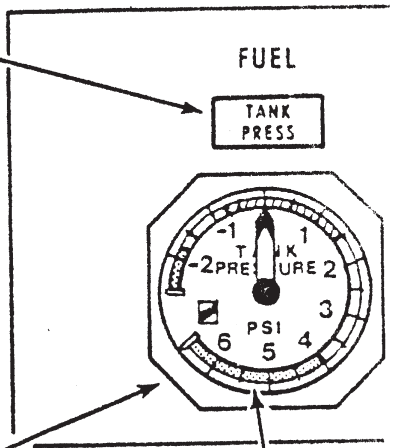
SCAVENGE PUMP MI

OFF

ON - indicates the pump is running. The scavenge pump removes any fuel that has entered the scavenge tank from the main tanks, through the vent system, and returns it to tank 3. Operation of the pump is automatic.

TANK PRESS LIGHT (Amber)

On - indicates one of three conditions:
The fuel vent gallery to atmosphere differential pressure is high and rising, or low and falling, or the vent gallery absolute pressure is below 2 psi at altitude.
Accompanied by the master warning FUEL light (amber) and audio (gong).



TANK PRESSURE GAUGE

Shows the pressure differential between the pressure in the right-hand vent gallery and static pressure.
A red and black flag in a window on the left-hand side of the gauge indicates a power loss or indication failure.
Two red secondary pointers remain at the maximum and minimum pressure difference attained during operation.
The secondary pointers are reset using the ENG LIMIT RESET push button.

KEY:-

▩ AMBER
▨ GREEN
☐ YELLOW